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WAR DEPARTMENT

TECHNICAL MANUAL



ORDNANCE MAINTENANCE

ANTIAIRCRAFT BATTERY COMMANDER'S

OBSERVATION INSTRUMENT M1

MARCH 2, 1943

FOR ORDNANCE PERSONNEL ONLY

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ORDNANCE MAINTENANCE

ANTIAIRCRAFT BATTERY COMMANDER'S

OBSERVATION INSTRUMENT M1

Prepared under the direction of the
Chief of Ordnance

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* This TM supersedes TR 1320-DO, March 14, 1939.

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ORDNANCE MAINTENANCE—ANTI-AIRCRAFT BATTERY COMMANDER'S OBSERVATION INSTRUMENT M1

Section I

INTRODUCTION

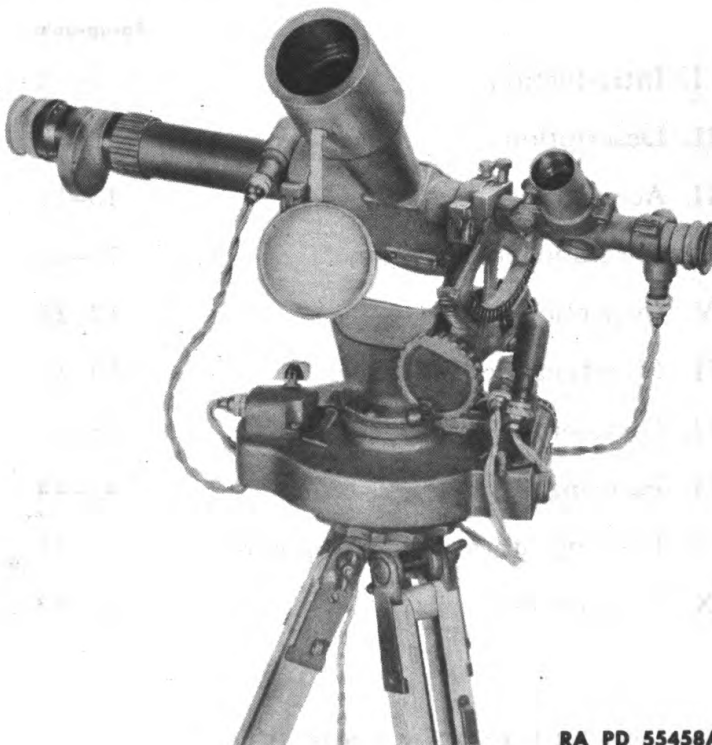
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1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of the Anti-aircraft Battery Commander's Observation Instrument M1, supplementary to those in the field and technical manuals prepared for the using arms. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the materiel.

2. CHARACTERISTICS.

a. The Antiaircraft Battery Commander's Observation Instrument M1 is the standard antiaircraft observation instrument. It is used for spotting in observation and tracking of rapidly moving aerial or ground



RA PD 55458A

Figure 1—A.A. B.C. Observation Instrument M1

INTRODUCTION

targets. It may also be used in lieu of a surveyor's transit for orienting the entire battery. Figure 1 shows the instrument set up ready for use.

b. The instrument measures horizontal angles from 0 to 6400 mils to within 0.1 mil and measures vertical angles from 0 to 1500 mils to within 1 mil.

c. The instrument has 2 separate optical systems: the observer's telescope (8-power), used by the observer for following the target, and the battery commander's telescope (10- to 20-power for Elbow Telescope M35, 10- or 20-power for Telescope M3), available to the battery commander at all times for observing and spotting.

d. The instrument has been modified as indicated below:

Principal Parts	Serial Nos. 1 to 534	Serial Nos. 535 to 1123	Serial Nos. 1124 Up
Mount	Has carbonized compression disk type rheostat Azimuth scale window A38263 is inside housing D9958 Slow motion arm thumb screw bracket is cast integral with housing	Has circular slide wire type rheostat Azimuth scale window A48842 is outside housing D29361 Slow motion arm thumb screws are on separate bracket A45429B	Same as 535 to 1123
Telescope for battery commander	Telescope M3	Same as 1 to 534	
Telescope for observer	Elbow Telescope M2	Same as 1 to 534	
*Telescope for training purposes	Telescope M2A1	Same as 1 to 534	Discontinued

* Used only by National Guard and now discontinued. Not discussed in this manual.

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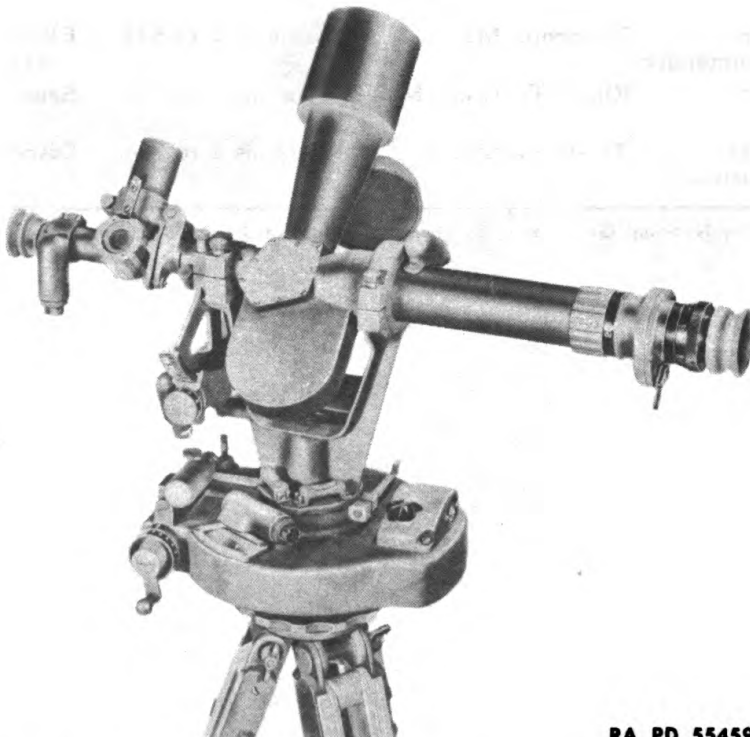
Section II

DESCRIPTION

	Paragraph
Components	3
Mount	4
Elbow telescope M35	5
Telescope M3	6
Elbow telescope M2	7
Type A tripod	8
Operation	9

3. COMPONENTS.

a. The components of the complete instrument are the mount, the Elbow Telescope M35 or Telescope M3, Elbow Telescope M2 and Type A Tripod. Included in the equipment (and described in section III) are wiring and battery for illumination of scales and reticle, and packing chests for the mount and telescope. Figure 2 shows the instrument with wiring removed.



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Figure 2—A.A. B.C. Observation Instrument M1—Rear View

DESCRIPTION

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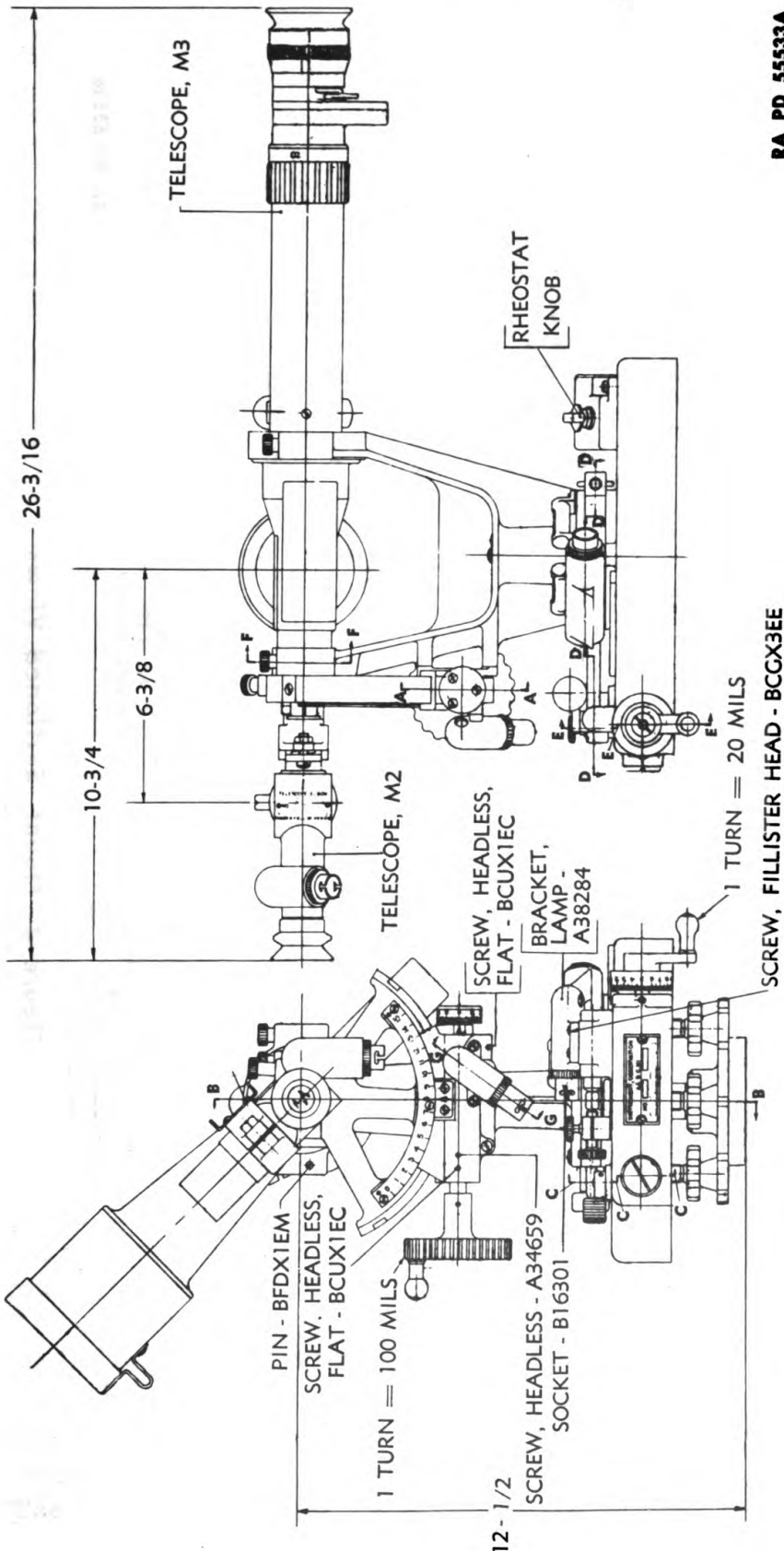
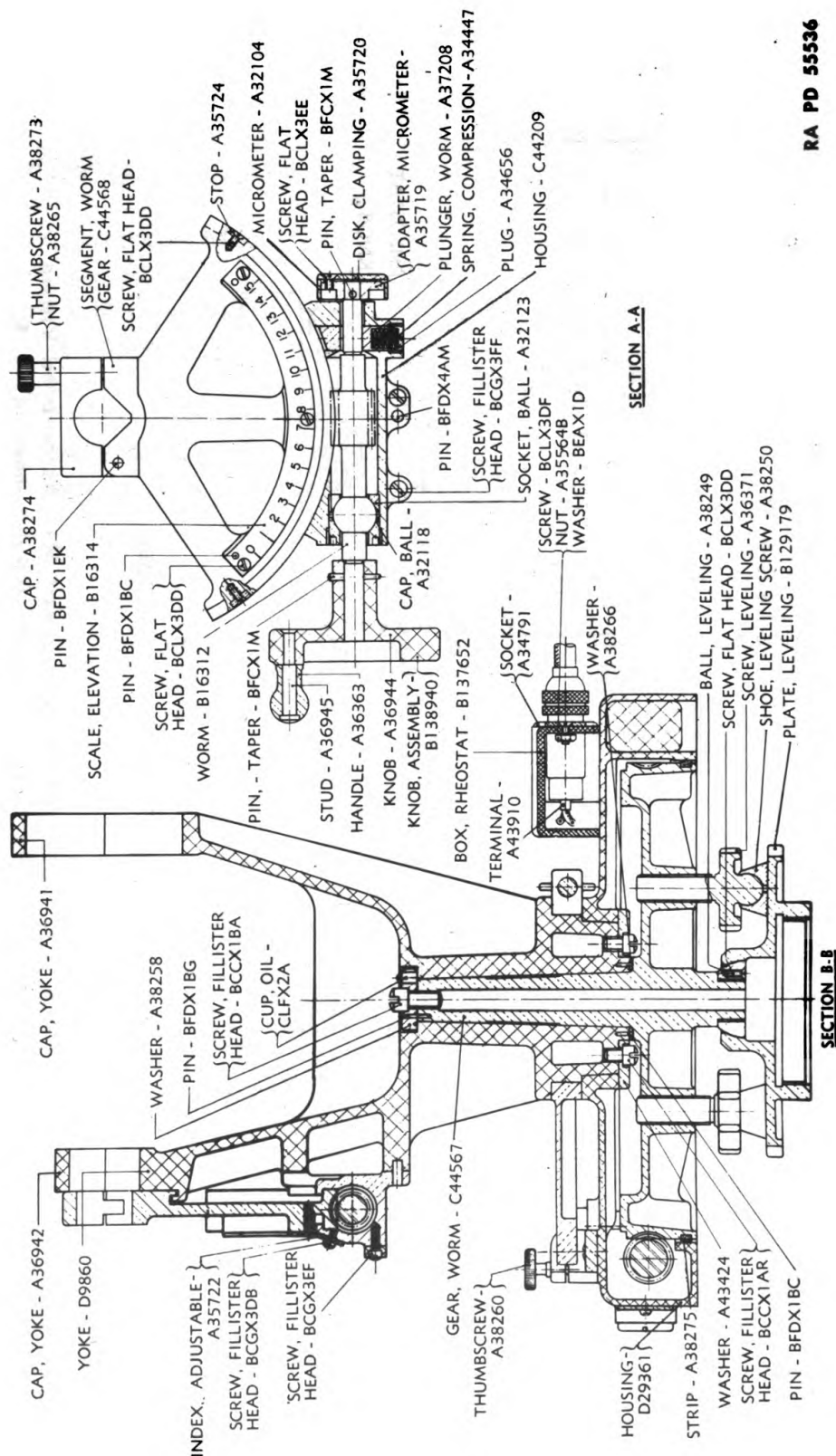


Figure 3—A.A. B.C. Observation Instrument M1—Assembled Views
(Sections A-A and B-B Shown In Fig. 4. Section D-D-D-D Shown In Fig. 5.
Sections C-C-C, E-E-E, F-F And G-G Shown In Fig. 6)

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Figure 4—Mount—Sectioned Views
(For Location Of Sections See Fig. 3)

DESCRIPTION

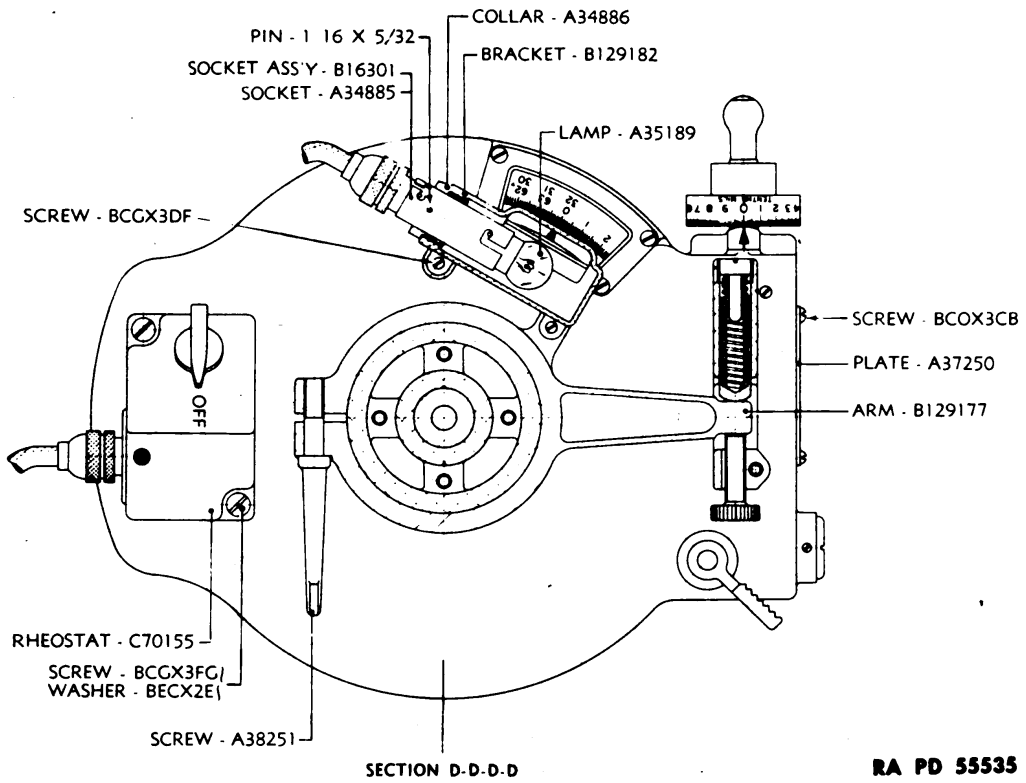


Figure 5—Mount—Sectioned View
(For Location Of Section See Fig. 3)

4. MOUNT.

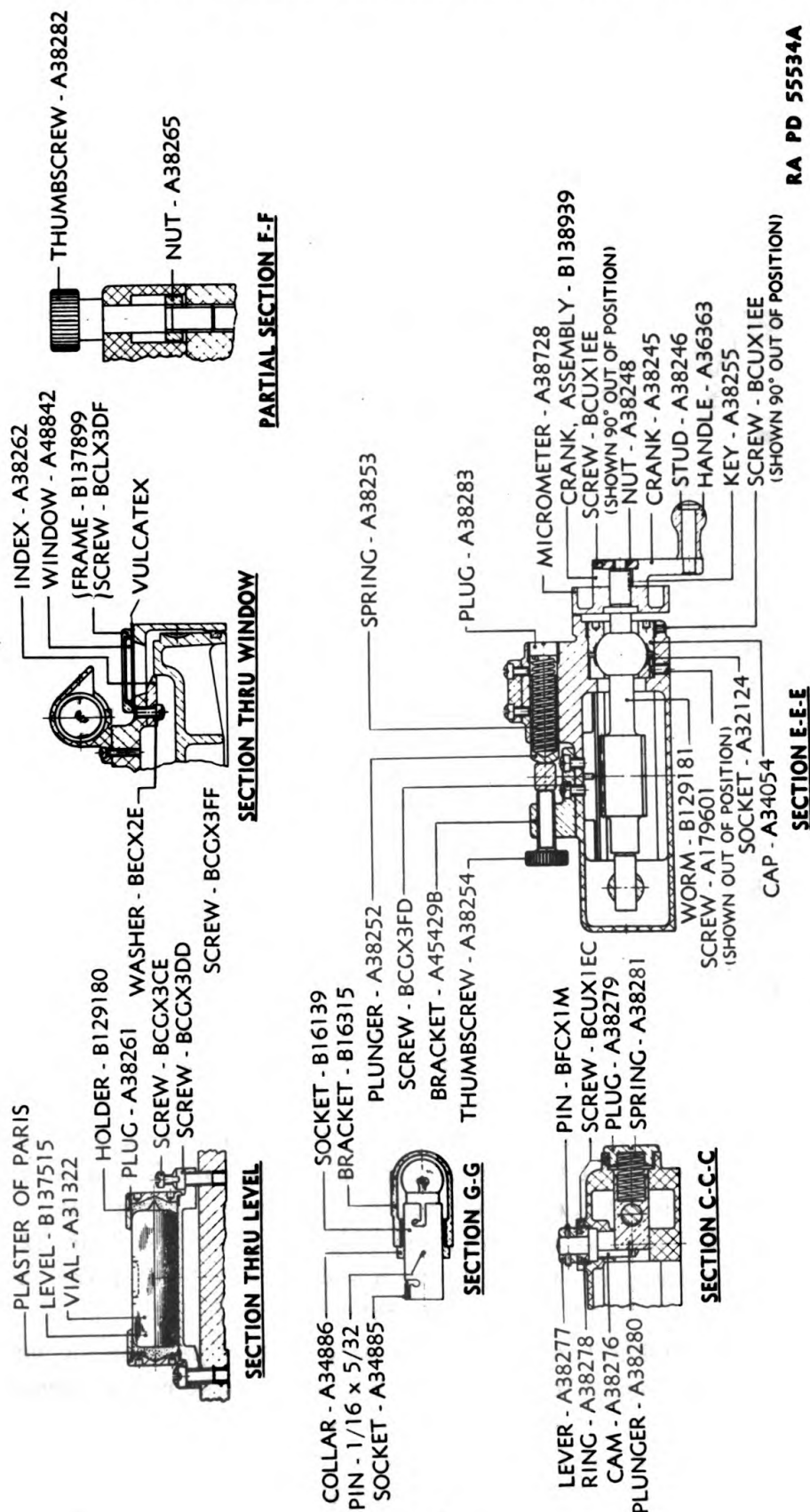
a. The mount (figs. 4 to 9) supports the telescope and contains leveling, elevating, and azimuth mechanisms and lighting equipment.

(1) The mount is secured to the tripod by the leveling plate which has an internal screw thread fitting the tripod head.

(2) The azimuth worm gear C44567 is attached to the leveling plate B129179 by a leveling ball A38249 and 4 leveling screws A36371. The azimuth scale is engraved on the upper surface of the worm gear, graduated at 10-mil intervals and numbered at 100-mil intervals. The inner row of graduations, 0 to 64 forms the main azimuth scale. The outer row of graduations, 0 to 32 paralleling the 32 to 64 graduations of the inner row, is provided for use with sighting materiel graduated 0 to 3200, 0 to 3200. The scales are visible through a window A48842 in the housing D29361 and are read against the azimuth index A38262.

(3) The yoke D9860 and azimuth housing D29361 pivot on the worm gear spindle. The caps A36941 and A36942 on the yoke fit the telescope trunnions. The caps have thumbscrews A38273 for rapid clamping. The worm gear segment C44568 moves the telescope in elevation. The scale B16314 attached to the segment is graduated and numbered at

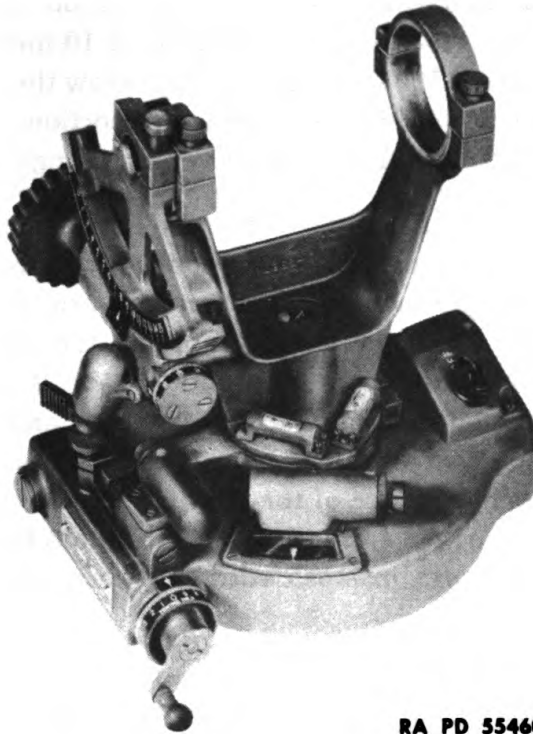
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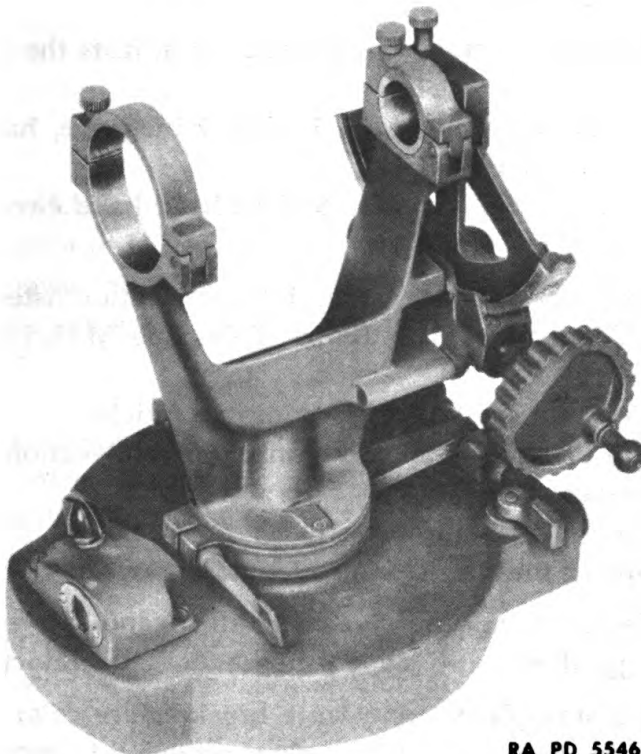
Figure 6—Mount—Sectioned Views
(For Location Of Sections See Fig. 3)

DESCRIPTION



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Figure 7—Mount—Rear View



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Figure 8—Mount—Front View

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100-mil intervals from 0 to 1500 mils. The elevation micrometer A32104 is graduated at 1-mil intervals and numbered at 10-mil intervals. A lamp bracket B16315 fastened to the segment just below the index, illuminates the coarse elevation scale B16314. The lower portion of the yoke carries 2 level vials A31322 which are mounted at right angles with each other.

(4) The azimuth mechanism is contained in the housing D29361 and, meshing with the worm gear, turns the housing with respect to the gear. The azimuth mechanism includes the azimuth worm B129181, the crank A38245 which is keyed to the worm shaft, and the azimuth micrometer A38728. The azimuth micrometer is graduated at 0.1-mil intervals and numbered at 1-mil intervals. One turn of the crank and micrometer turns the telescope 20 mils in azimuth. The azimuth worm throwout lever A38277 permits rapid traverse of the instrument. Movement of the lever turns a cam which shifts a spring backed plunger A38280. The plunger normally holds the worm in mesh with the worm gear, thus taking up backlash.

(5) The azimuth slow motion arm B129177 provides rotation of the housing with respect to the yokes, for orientation. Thumbscrews A38251, A38254, and A38260 permit adjustment and locking.

(6) Illumination is provided for the reticle of each telescope, for the scales and micrometers.

(a) The rheostat mounted on the housing adjusts the illumination of the telescope reticle.

1. Instruments, serial numbers 1 to 534 inclusive, have carbonized compression disk type rheostats.

2. Instruments, serial numbers 535 and up, have circular slide wire type rheostats.

(b) One lamp bracket is provided in each location listed below:

1. On the Telescope M3 or Elbow Telescope M35, illuminating the reticle.

2. On the Telescope M2, illuminating the reticle.

3. Below the elevation scale, illuminating the elevation scale and elevation micrometer.

4. On the housing, illuminating the azimuth scale.

5. Above the azimuth micrometer, illuminating the micrometer.

(c) The electric lamps provided are all 3-candlepower, 6- to 8-volt miniature lamp, Mazda G-6, bayonet base, double contact type.

(d) The rheostat (fig. 9) and lamp brackets are color coded (par. 9 a (1) (h) and fig. 49). The mating plugs provided to complete the electrical connections are correspondingly colored.

DESCRIPTION

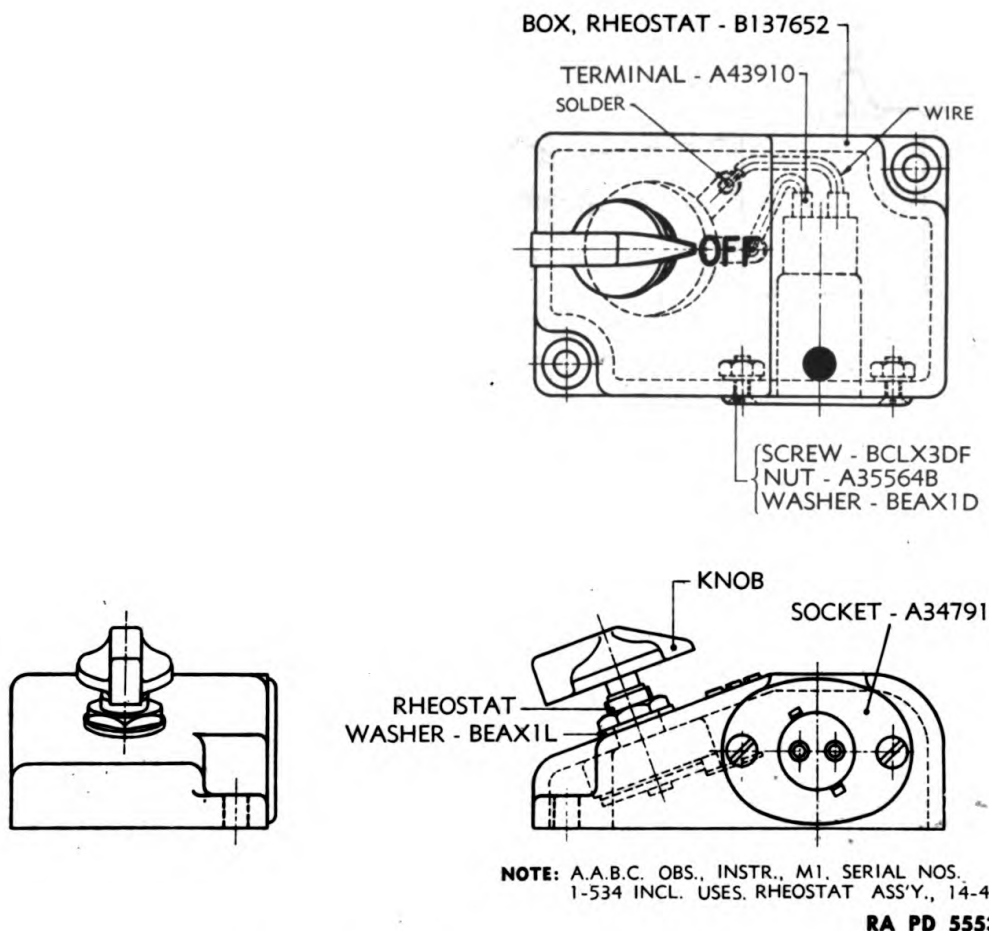


Figure 9—Rheostat Box Assembly

5. ELBOW TELESCOPE M35.

a. The Telescope M35 (figs. 10 to 26) is adjustable in magnification, between 10 power and 20 power, for varying conditions. The optical characteristics at 10 and 20 power are as follows:

Magnification	10X	20X
Field of view	6 deg 9 min	3 deg 5 min
Diameter of exit pupil	0.25 in.	0.125 in.
Equivalent focal length of objective	12.5 in.	12.5 in.
Equivalent focal length of eyepiece	1. in.	1. in.

b. The optical system (fig. 11) includes an objective A37199, a penta prism A37206, a reticle A37204 and reticle lens A184998, two erector lenses A184997 and A184993, amber A37232 and blue A37231 filters, diaphragm, field lens A184994, center lens A184996, and eyelens A184995.

c. The magnification of the telescope may be varied between 10 and 20 power by rotation of the knurled focusing sleeve A37229. This sleeve

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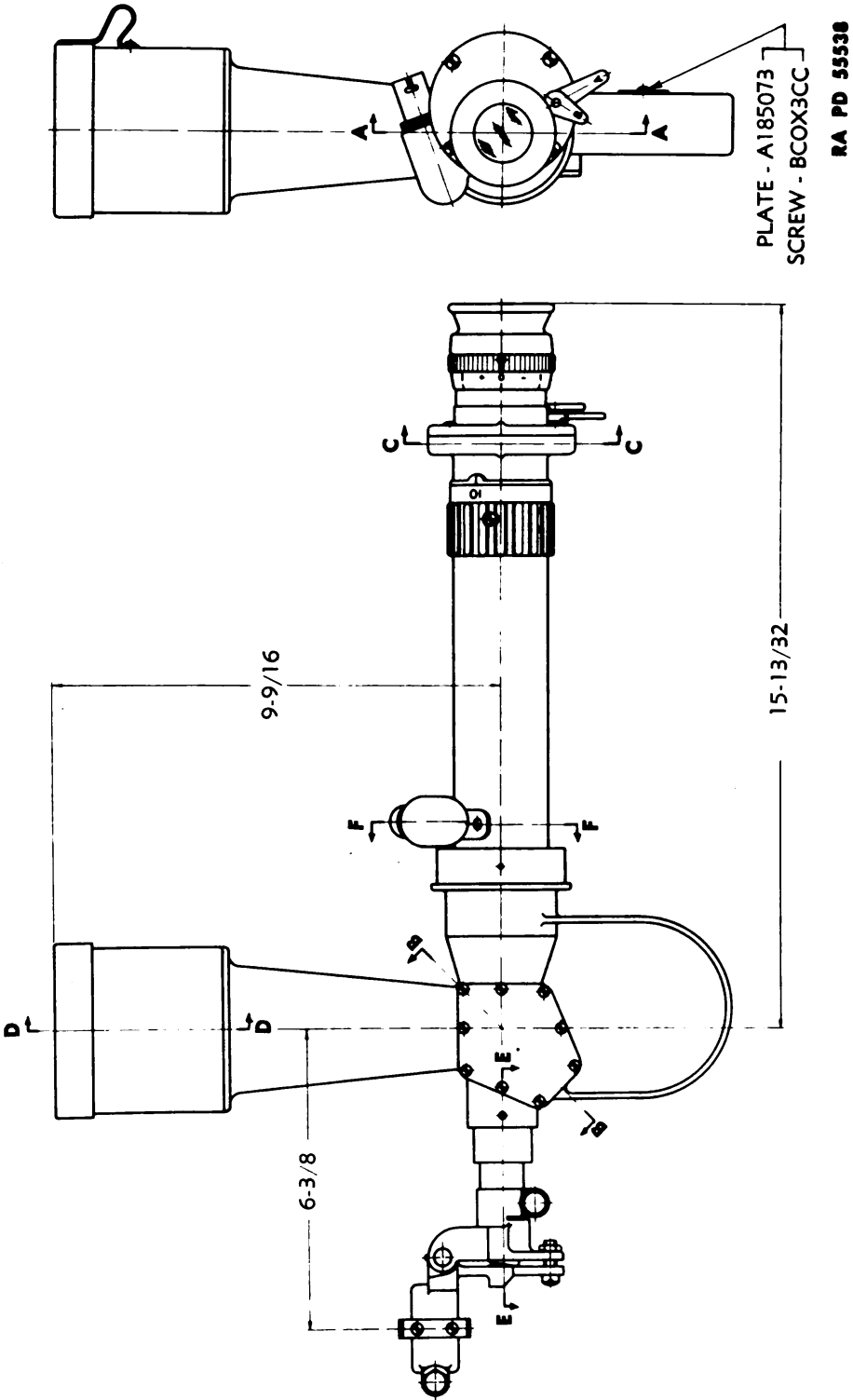


Figure 10—Elbow Telescope M35—Assembled Views
(Sections A-A, B-B And C-C Shown In Fig. 12. Sections D-D, E-E And F-F Shown In Fig. 21)

DESCRIPTION

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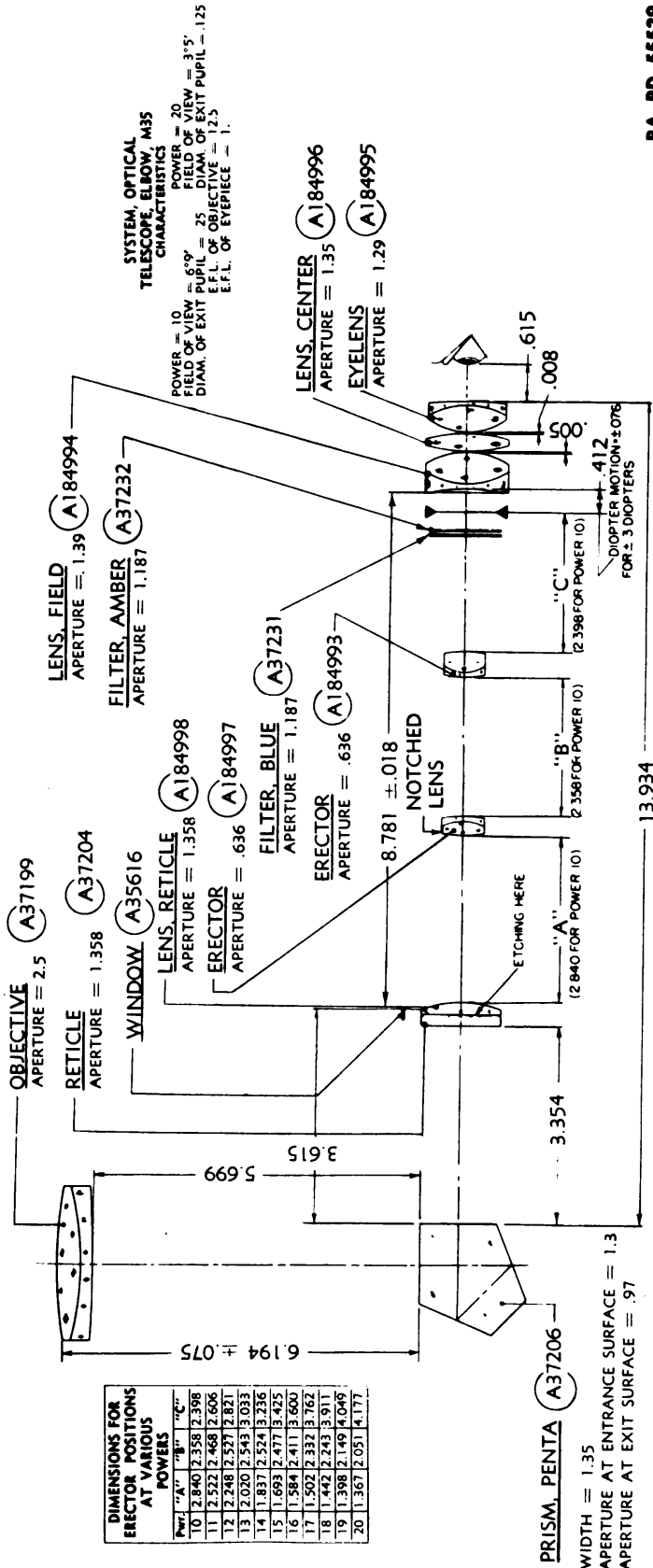
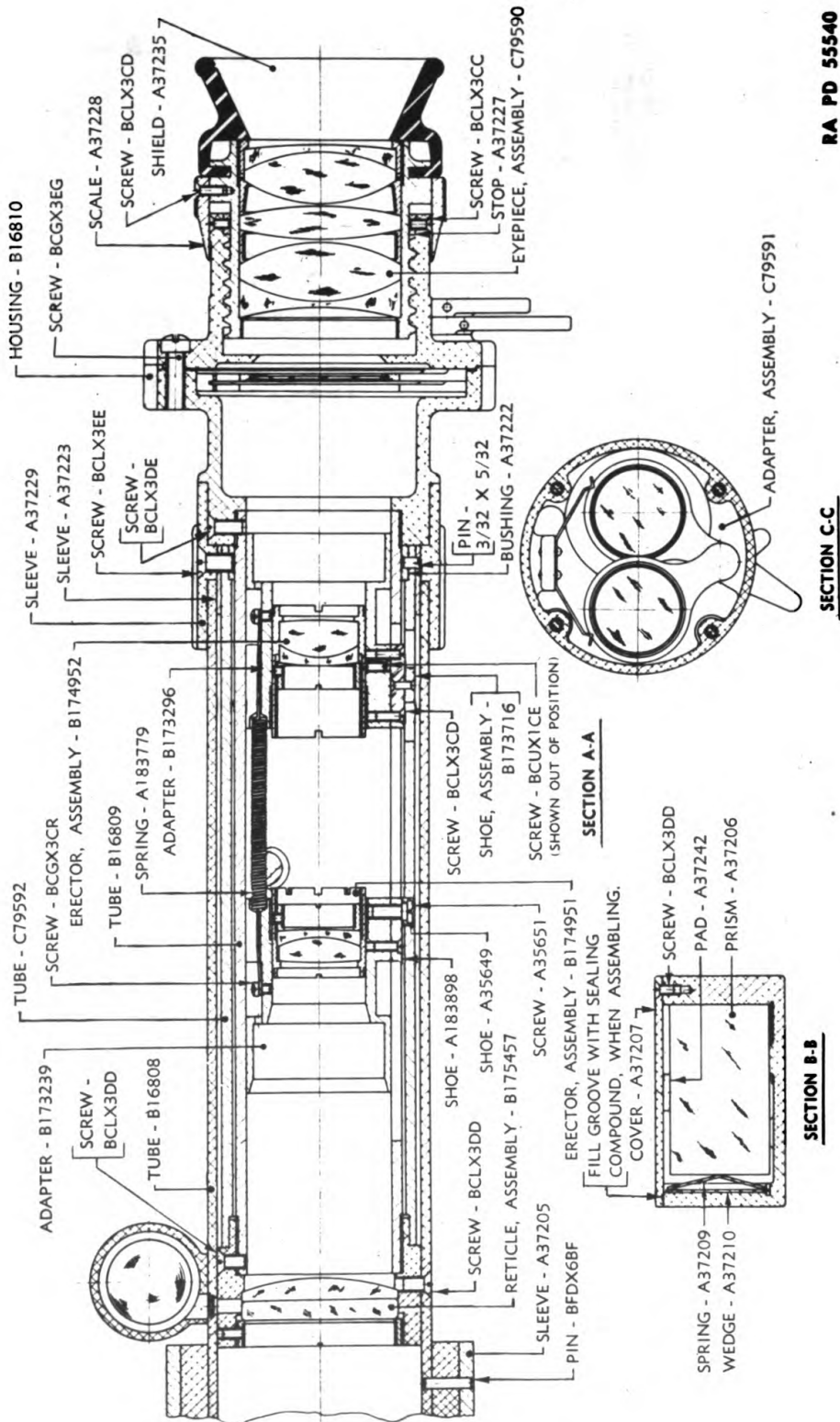


Figure 11—Elbow Telescope M35—Optical System

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Figure 12—Elbow Telescope M35—Sectioned Views
(For Location Of Sections See Fig. 10)

DESCRIPTION

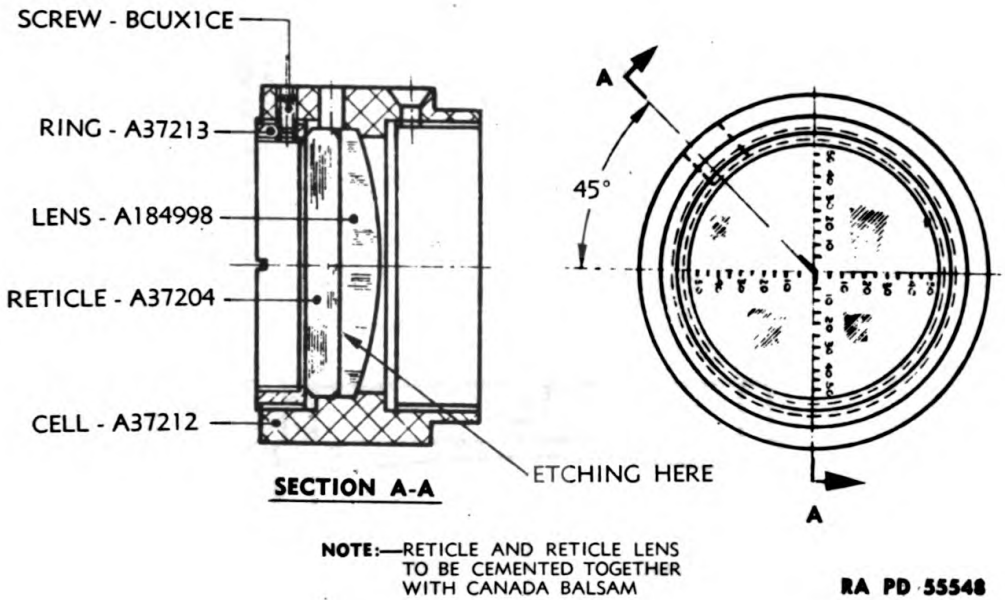


Figure 13—Elbow Telescope M35—Reticle Assembly

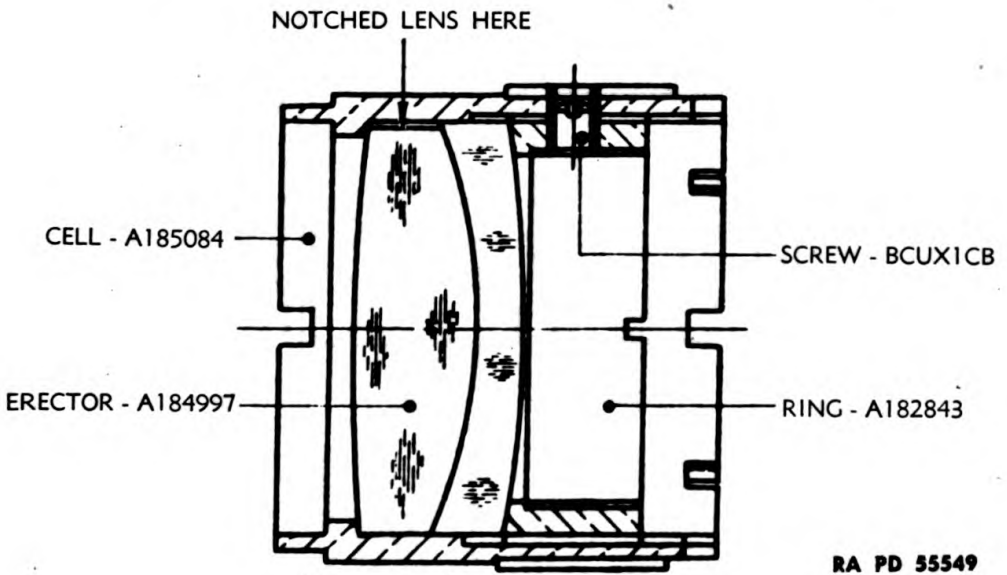
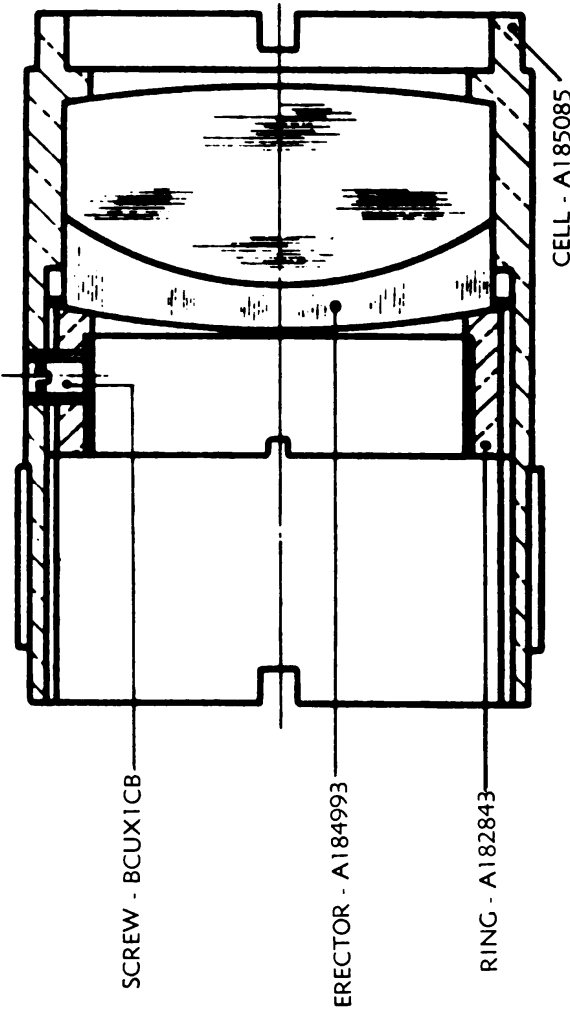


Figure 14—Elbow Telescope M35—Erector Assembly

in turn rotates the cam tube C79592. The cam tube has 2 helical slots of different pitch. These slots engage shoes A183898 and B173716 attached to both erector cells A185084 and A185085 (figs. 14 and 15). When the focusing sleeve is rotated, the erector cells slide. The coiled tension spring A183779 between the 2 erector cells takes up play between the shoes and the tube, and prevents backlash. Graduations on the focusing sleeve indicate the magnification.

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Figure 15—Elbow Telescope M35—Erector Assembly

DESCRIPTION

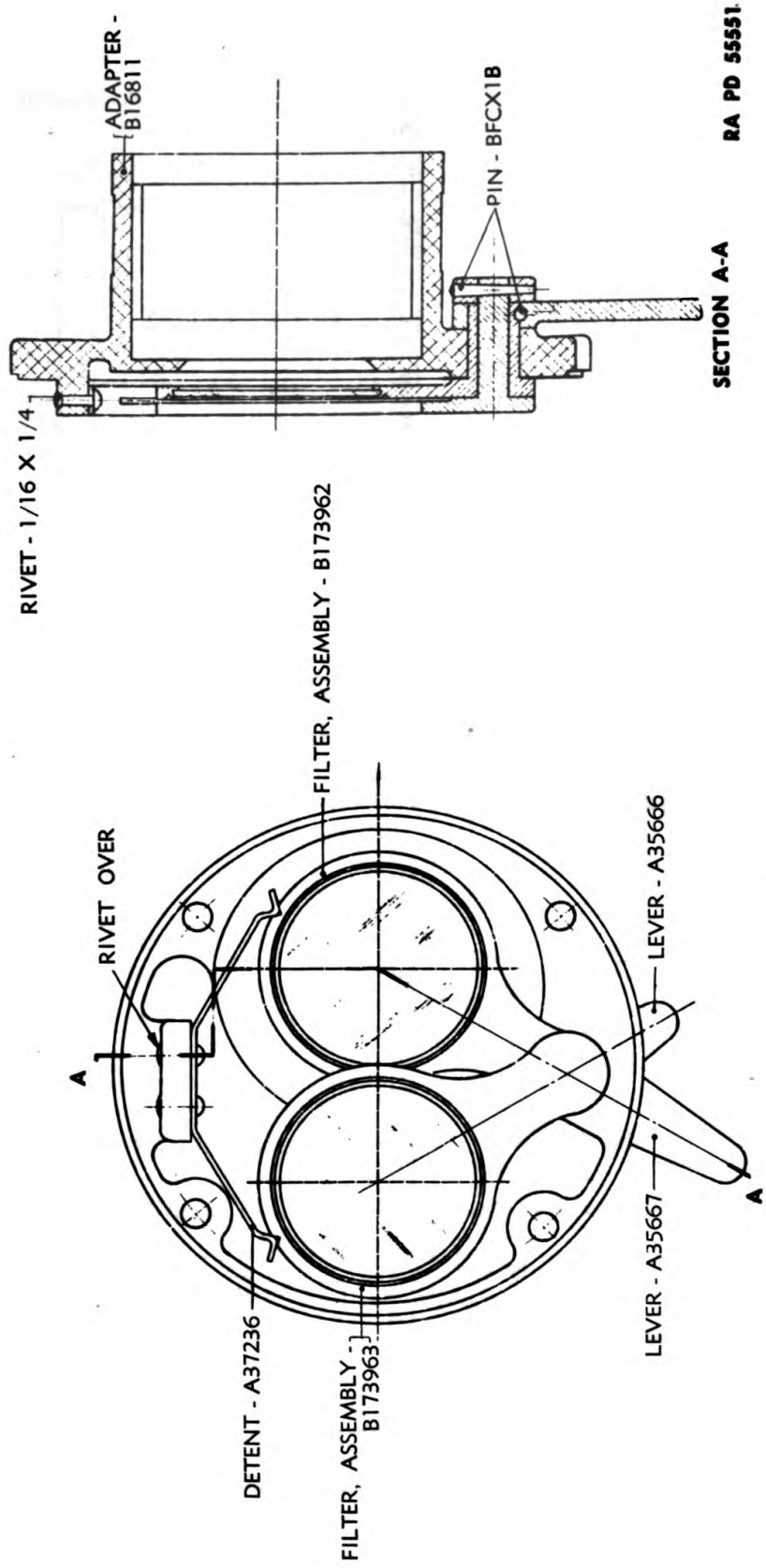


Figure 16—Elbow Telescope M35—Adapter Assembly

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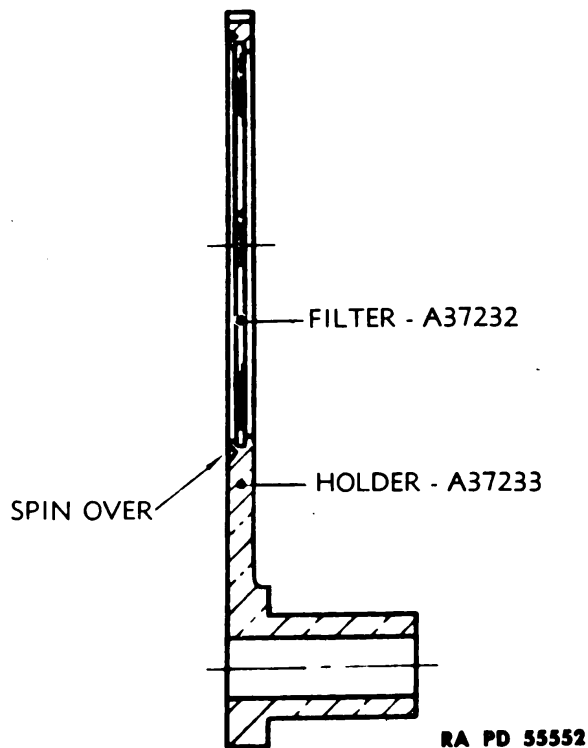


Figure 17—Elbow Telescope M35—Filter Assembly

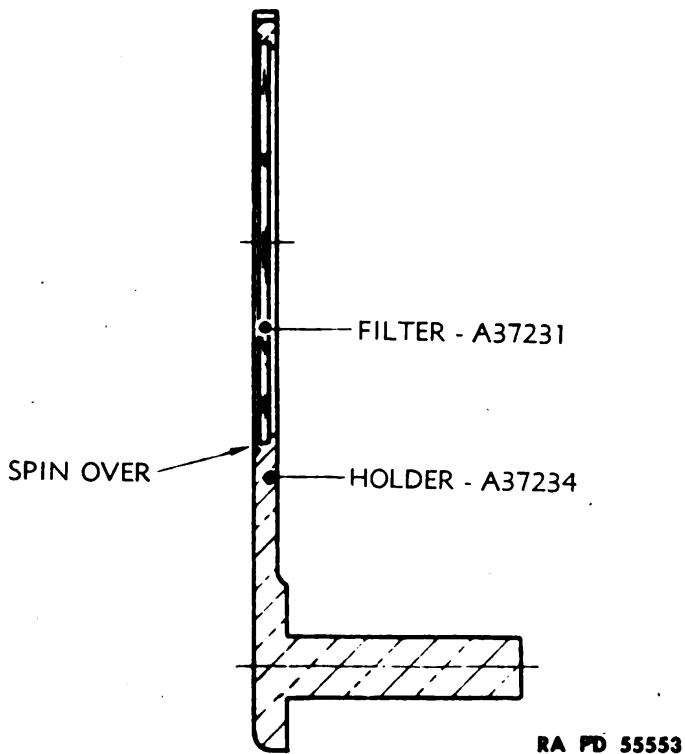
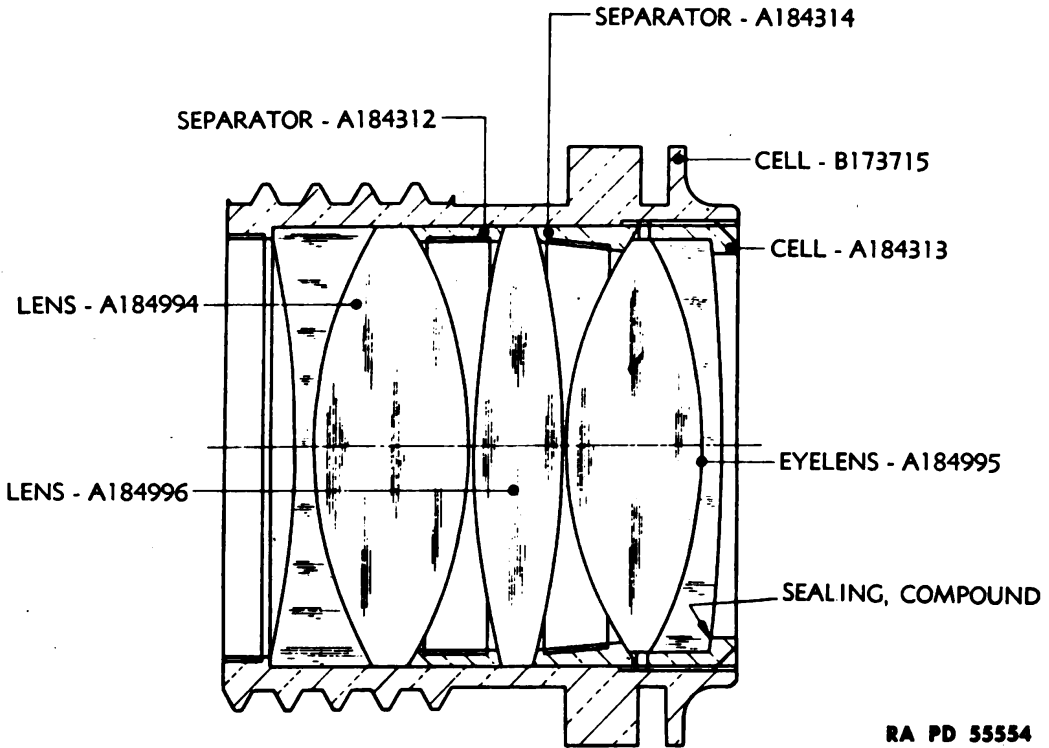


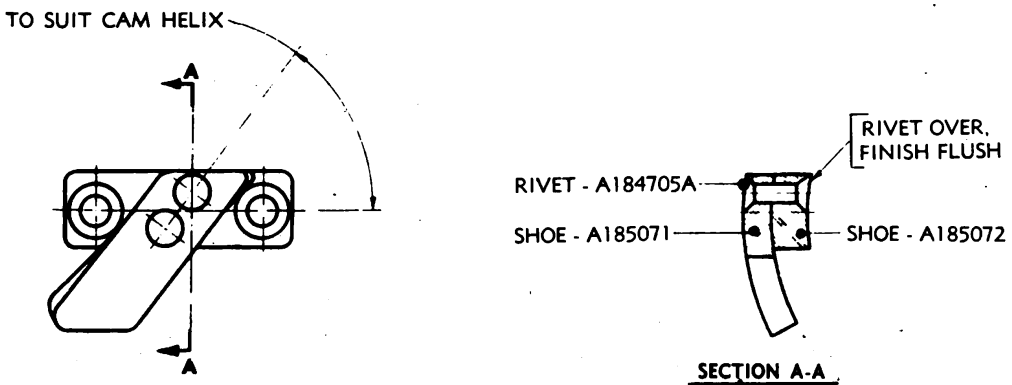
Figure 18—Elbow Telescope M35—Filter Assembly

DESCRIPTION



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Figure 19—Elbow Telescope M35—Eyepiece Assembly



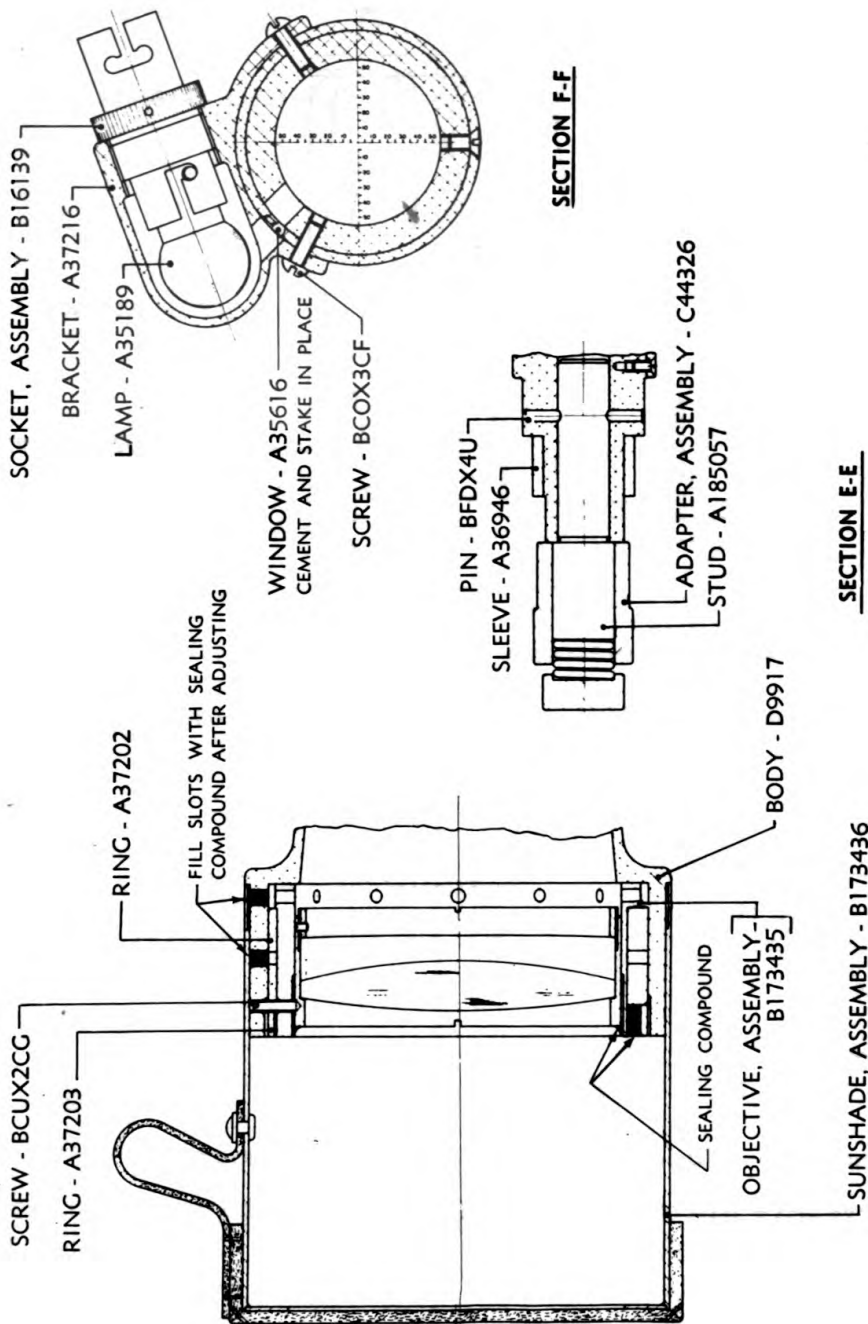
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Figure 20—Elbow Telescope M35—Shoe Assembly

d. The eyepiece assembly C79590 (fig. 19) may be focused to accommodate the eye. The diopter scale, graduated from plus 3 to minus 3 diopters, permits immediate setting in the correction for an observer's eye when this is known.

e. Two internal filters, one amber A37232 (fig. 17) and one blue A37231 (fig. 18), are provided in the telescope. Each is controlled by a lever extending outside the housing B16810. The longer lever A35667, labeled "A," controls the amber filter. The shorter lever A35666, labeled "B," controls the blue filter.

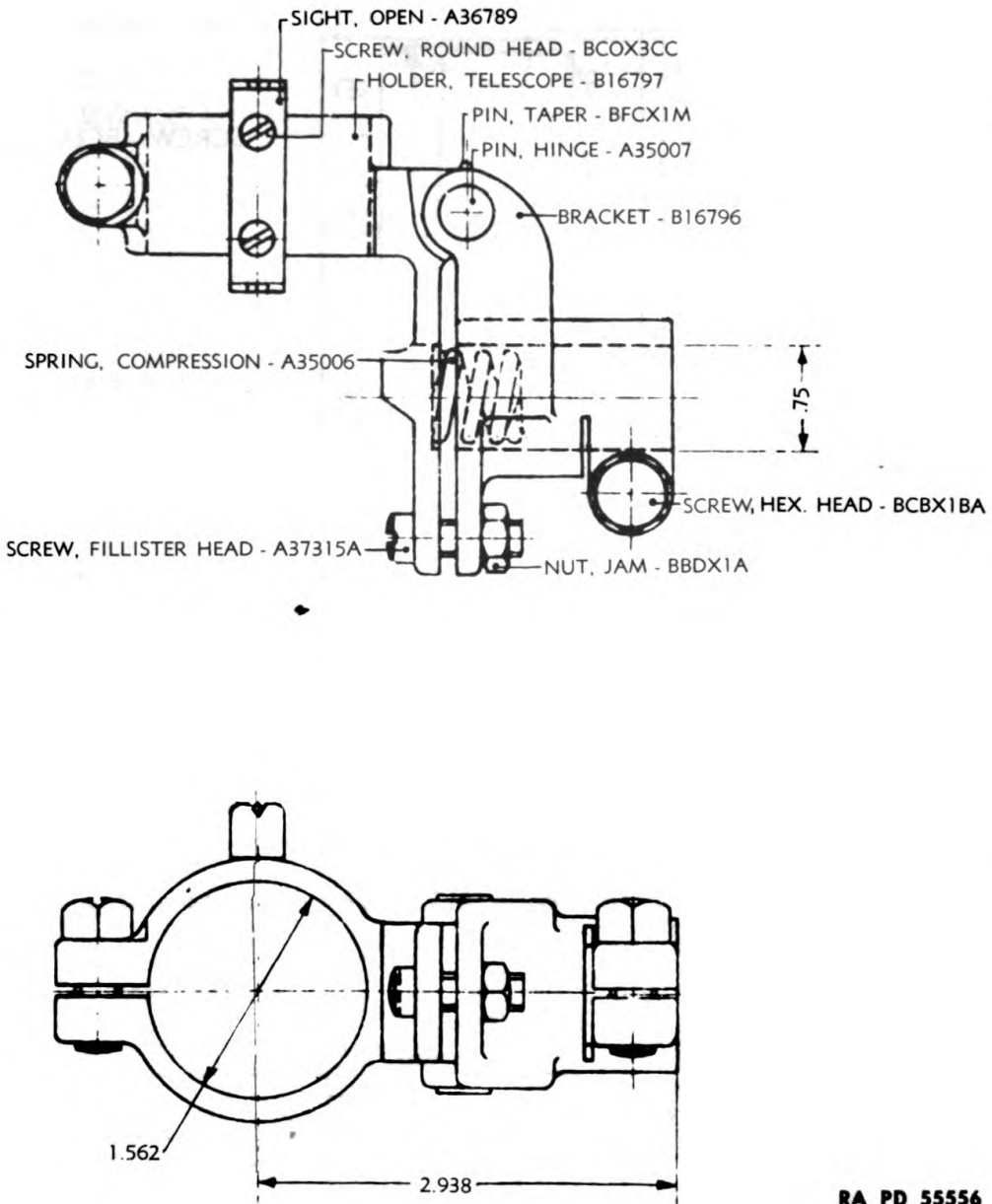
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Figure 21—Elbow Telescope M35—Sectioned Views
(For Location of Sections See Fig. 10)

DESCRIPTION



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Figure 22—Elbow Telescope M35—Telescope Adapter Assembly

f. The reticle assembly B175457 (fig. 13) of the telescope is graduated in mils, the least reading being 1 mil. The reticle pattern is shown in figure 26.

g. The telescope body has 2 bearing surfaces along the eyepiece leg of the telescope for clamping to the mount. These straddle the pocket holding the penta prism. The cover A37207 seals the pocket.

h. The body has a shaft extension, a portion of which has a flat

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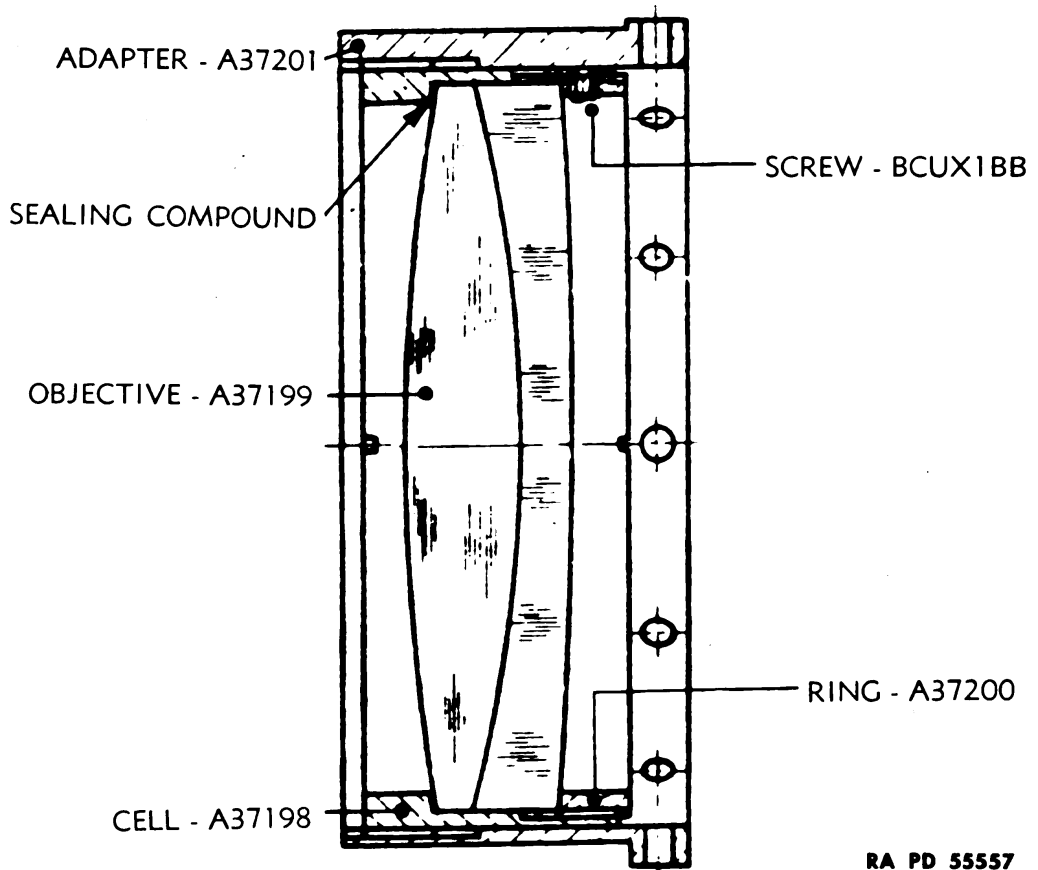


Figure 23—Elbow Telescope M35—Objective Assembly

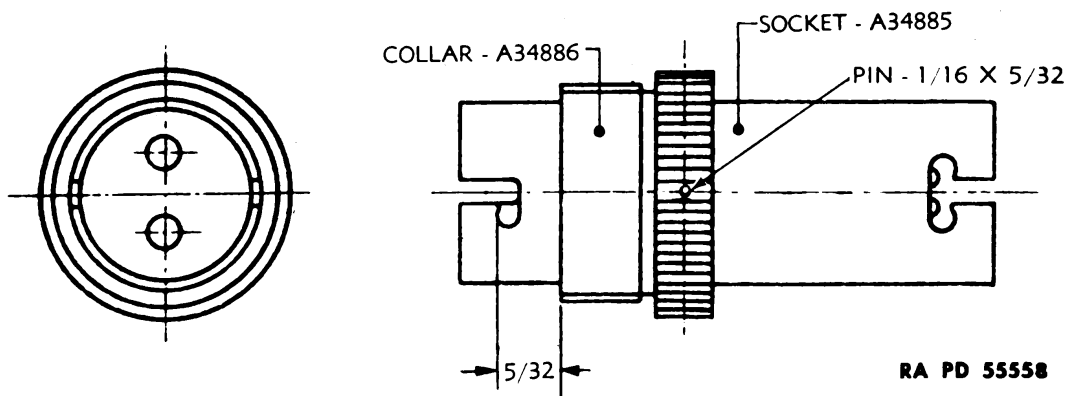
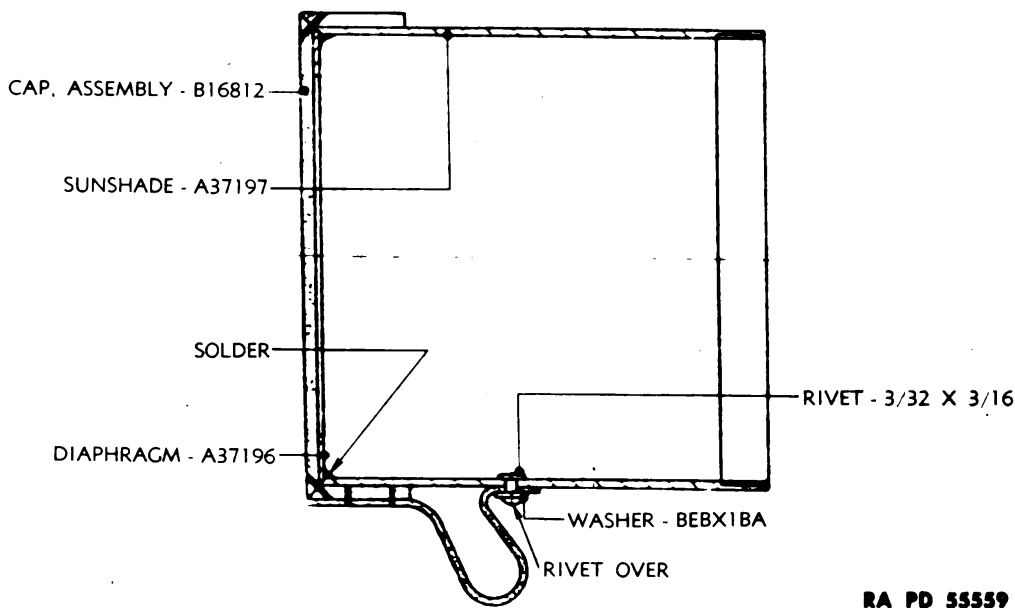


Figure 24—Elbow Telescope M35—Socket Assembly

locating surface for mounting and positioning of the worm wheel segment which clamps to the extension.

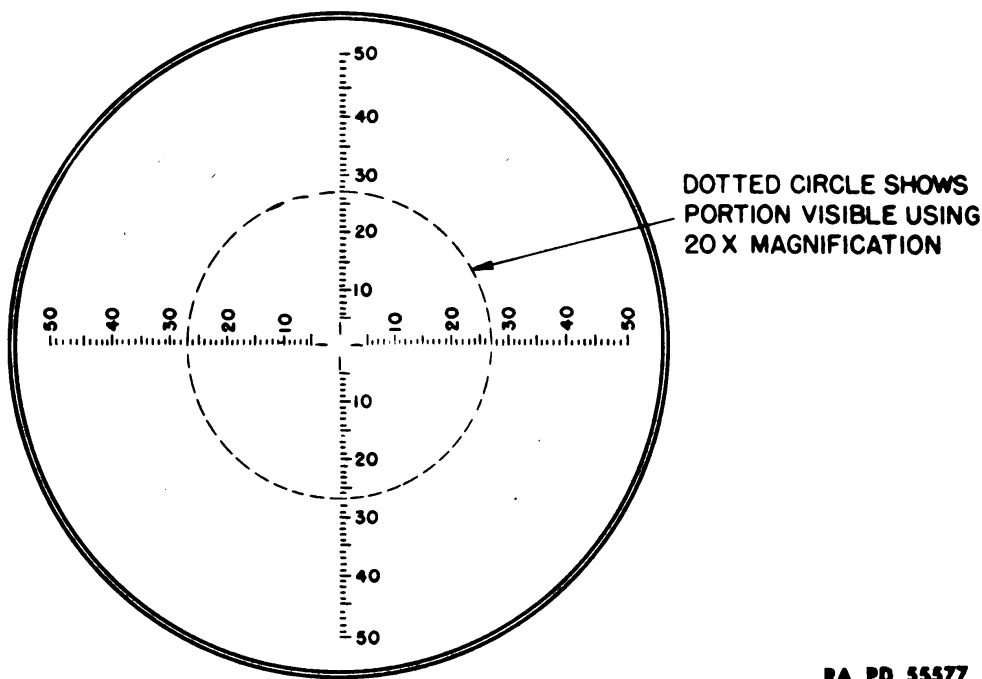
i. The adapter C44326 (fig. 22) for holding the Elbow Telescope M2 is clamped to a stud A185057 protruding from the shaft extension

DESCRIPTION



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Figure 25—Elbow Telescope M35—Sunshade Assembly



RA PD 55577

Figure 26—Telescope M3 And Elbow Telescope M35—Reticle Pattern

of the body. The adapter includes: a bracket B16796 which clamps to the stud, the telescope holder B16797 hinged to the bracket and carrying the telescope, spring A35006, screw A37315A and jam nut BBDX1A,

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and open sight A36789. The open sight enables the observer speedily to pick up the designated target.

j. The adapter provides two possible adjustments of the Elbow Telescope M2.

(1) After the inner hexagonal head bolt is loosened, the adapter may be rotated to set the Elbow Telescope M2 at the same elevation as the Elbow Telescope M35.

(2) Adjustment of the screw and jam nut against the spring sets the objective axis of the Elbow Telescope M2 parallel to the plane of rotation of the objective axis of the Elbow Telescope M35.

k. The body of the telescope contains a pocket filled with lead to counteract the unbalance of the objective legs of the 2 elbow telescopes.

l. A leather objective cap attached to the sunshade protects the objective when the telescope is not in use.

6. TELESCOPE M3.

a. The Telescope M3 is used in instruments, serial numbers 1 to 1123 inclusive (figs. 27 to 35). The telescope is furnished with either of 2 interchangeable eyepieces. The telescope is adjustable in magnification, giving 10 power or 20 power for varying conditions. The optical characteristics of the Telescope M3 are the same as those of the Elbow Telescope M35.

b. The Telescope M3 differs from the Elbow Telescope M35 in the construction of the variable power mechanism, but is similar in external construction and operation.

7. ELBOW TELESCOPE M2.

a. The Elbow Telescope M2 is shown in figures 36 to 44. The optical characteristics are as follows:

Magnification	8 power
Field of view	8 deg 45 min
Diameter of exit pupil	0.144 in.
Equivalent focal length of objective	4.8 in.
Equivalent focal length of eyepiece	.602 in.

b. The optical system includes an objective A33906, Amici prism A36234, reticle A33909, field lens A33913, collective lens A33914, eyelens A33915, and blue A37320 and amber A37319 filters.

c. The eyepiece is fixed, no provision being made for adjustment of the eyepiece to accommodate the observer's eyes for various errors.

d. The open sight, secured to the top of the telescope, enables the observer to pick the target up rapidly.

e. The lamp bracket is arranged for right- or left-hand mounting, but should be mounted with joint down for protection against rain.

DESCRIPTION

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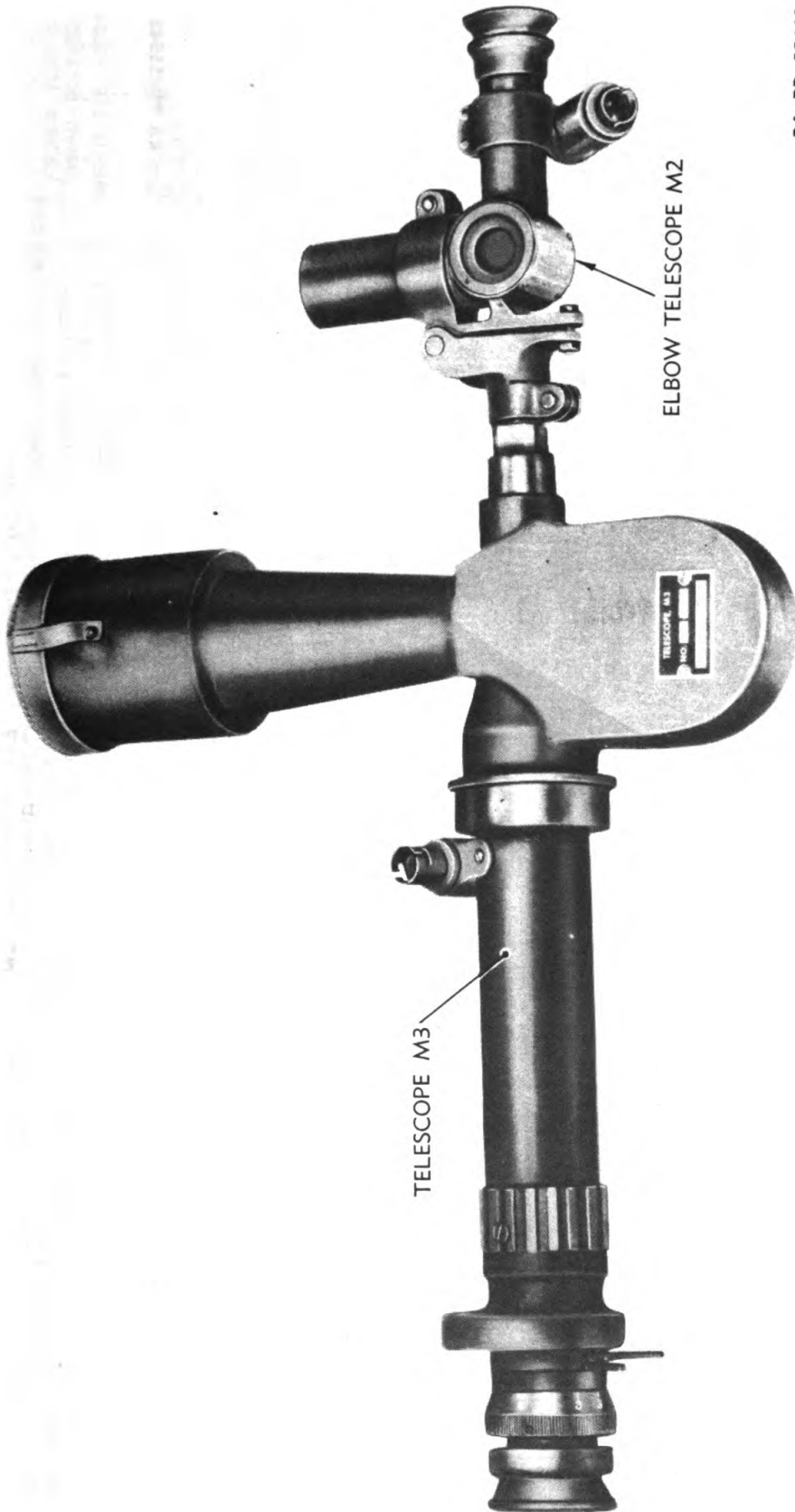
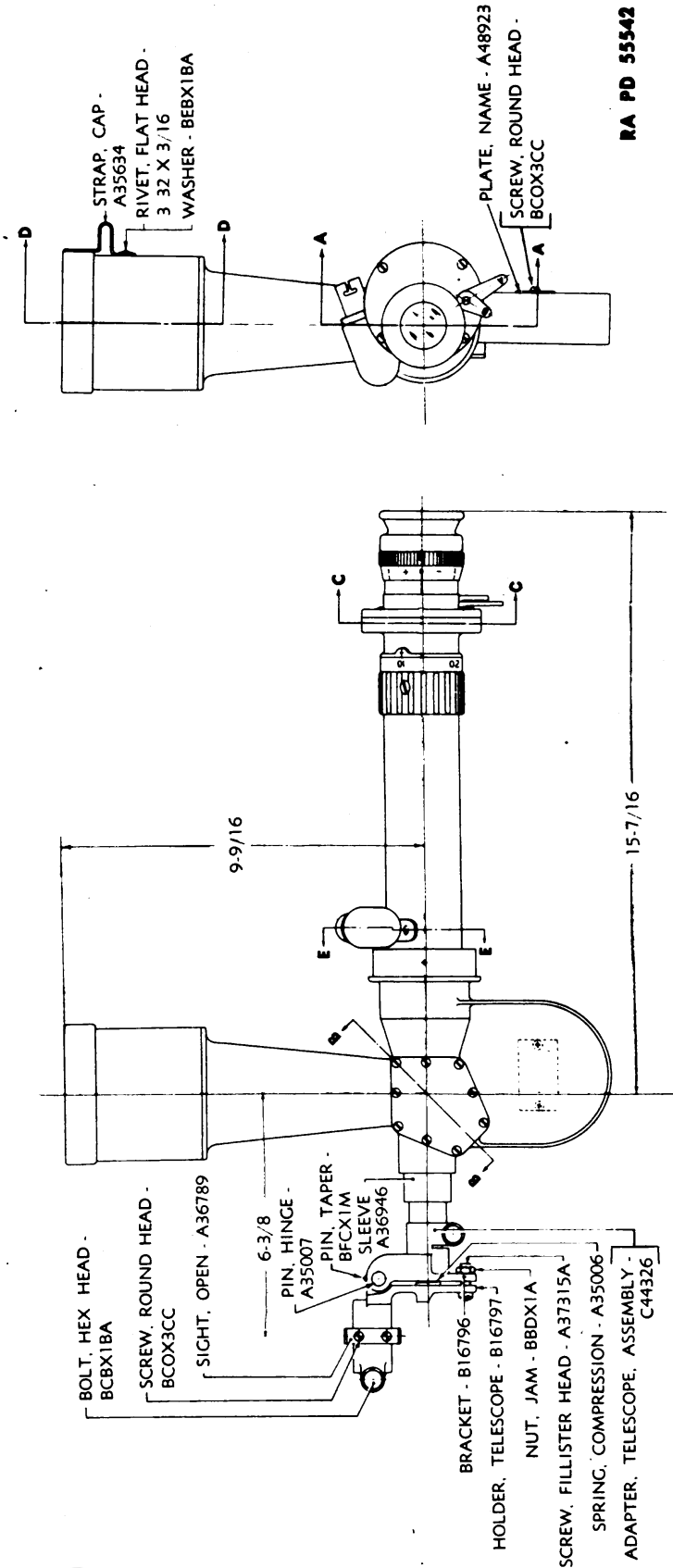


Figure 27 — Telescope M3 And Elbow Telescope M2

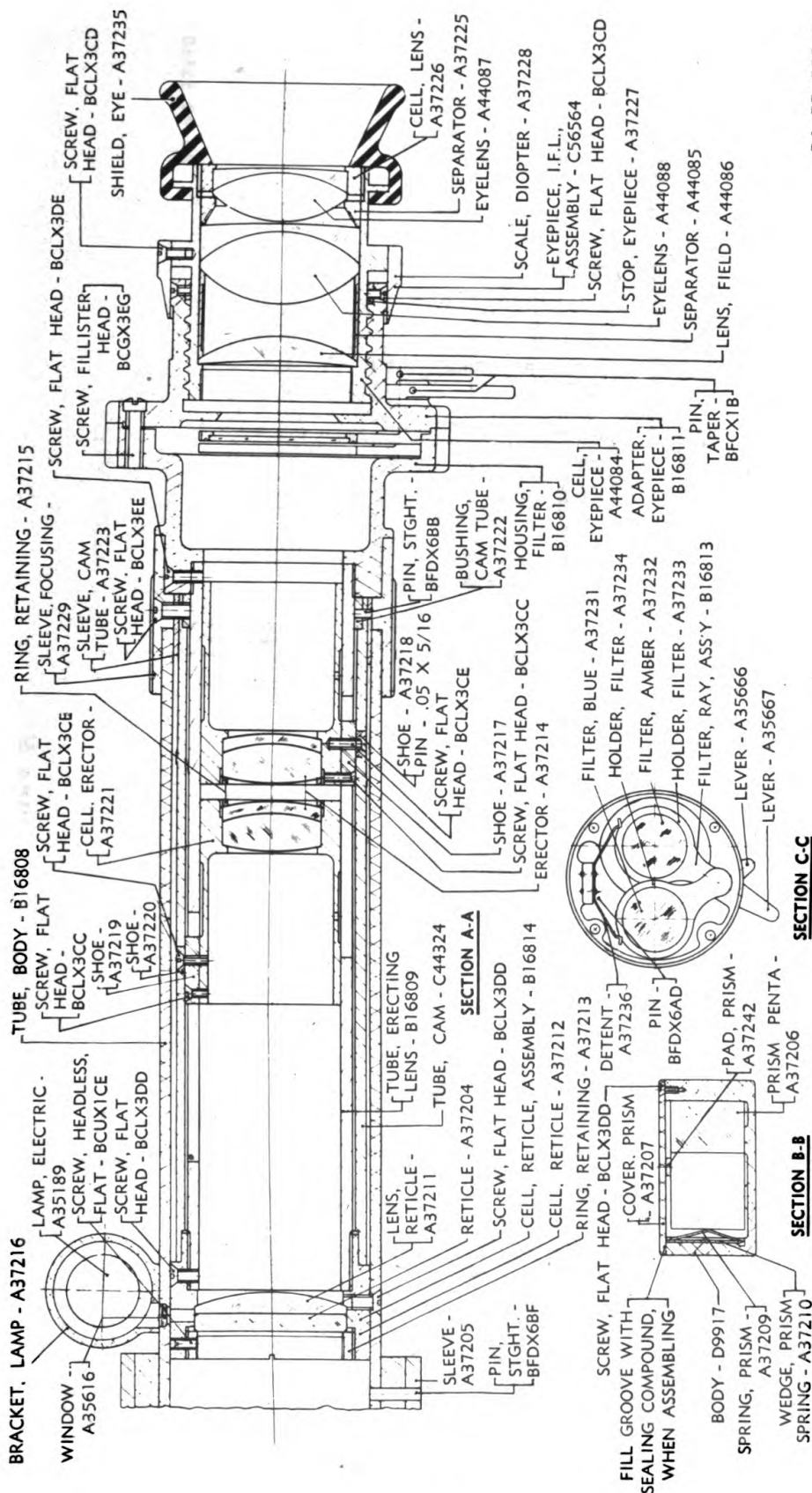
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Figure 28—Telescope M3—Assembled Views
(Sections A-A, B-B And C-C Are Shown In Fig. 29. Sections D-D And E-E Are Shown In Fig. 34)

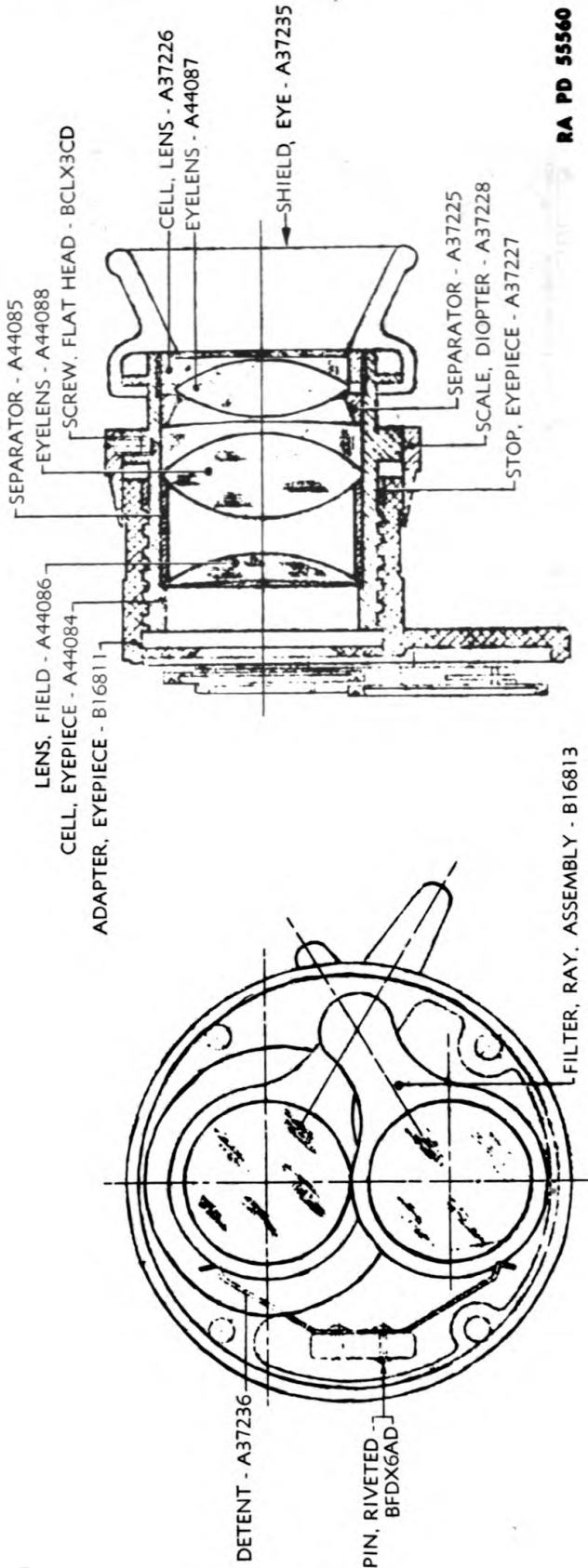
DESCRIPTION



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Figure 29—Telescope M3—Sectioned Views
 (For Location Of Section See Fig. 28)

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Figure 30—Telescope M3—Eyepiece Assembly

DESCRIPTION

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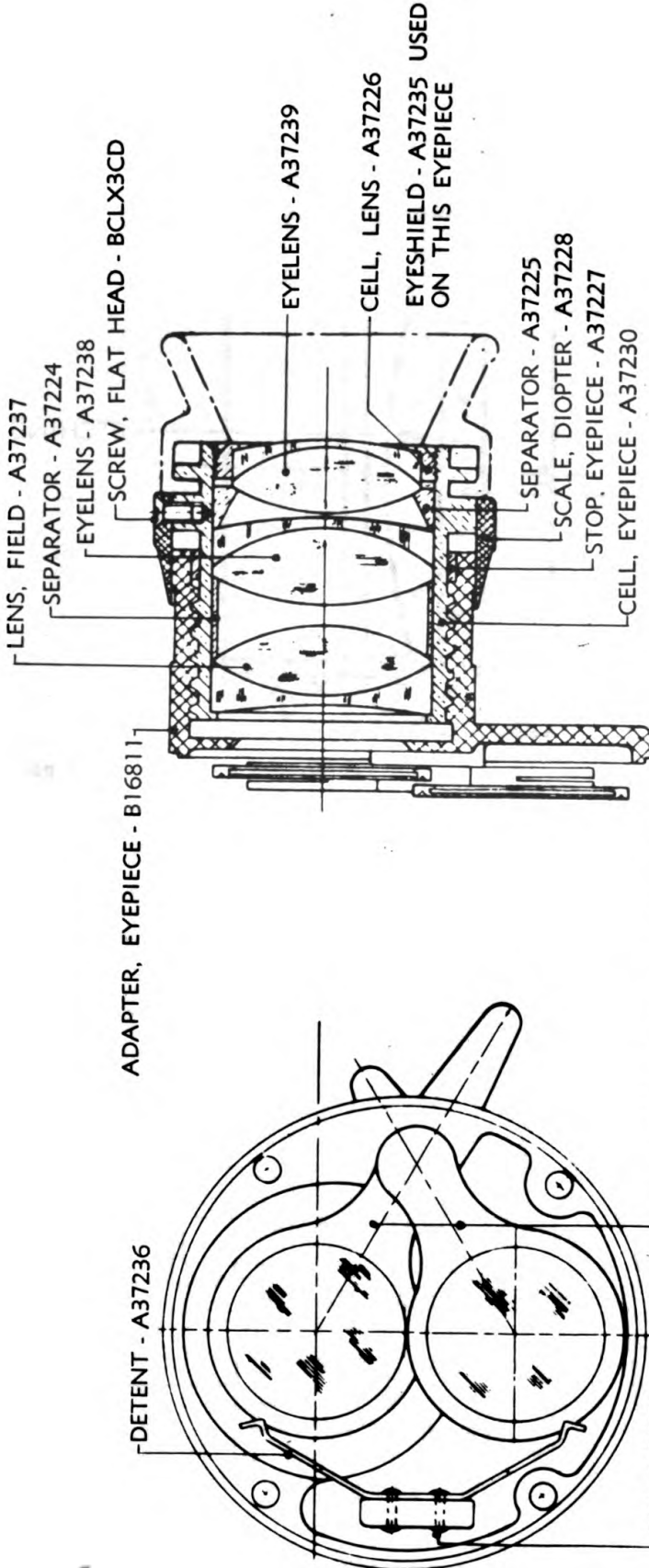


Figure 31 - Telescope M3 - Eyepiece Assembly

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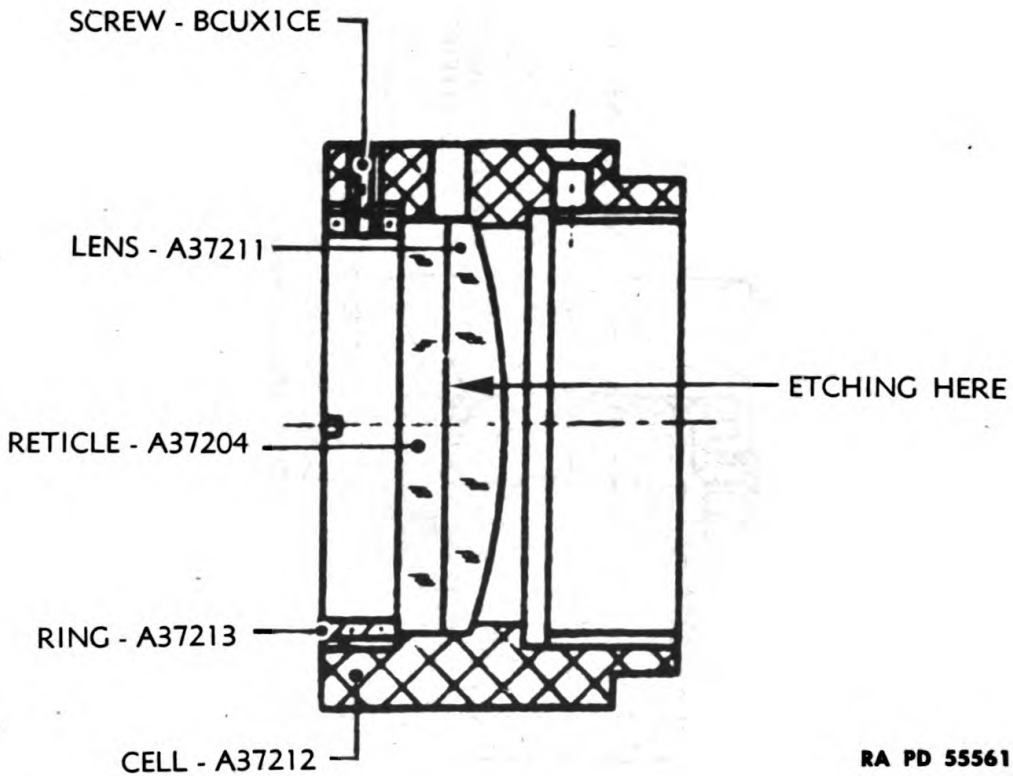


Figure 32—Telescope M3—Reticle Cell Assembly

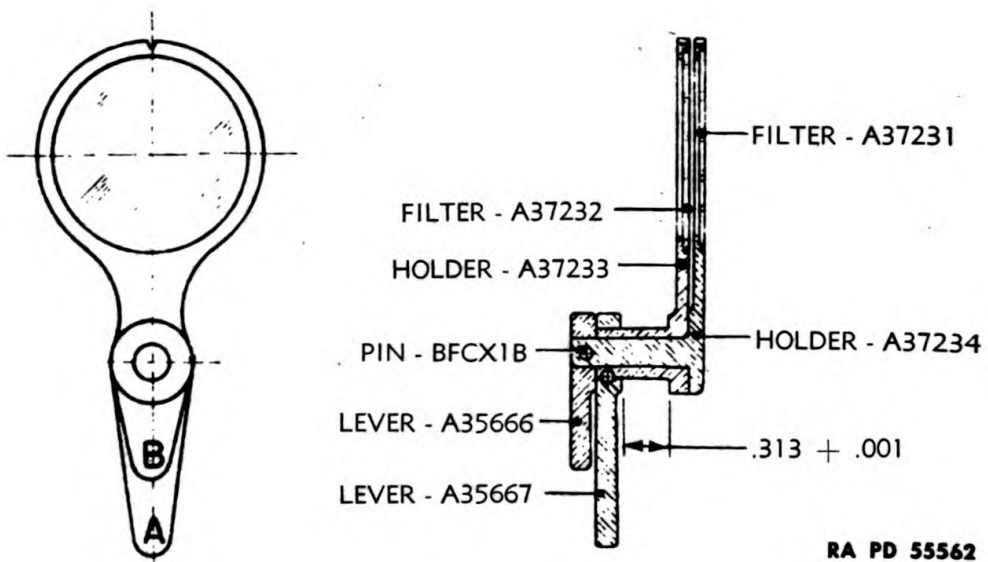


Figure 33—Telescope M3—Ray Filter Assembly

DESCRIPTION

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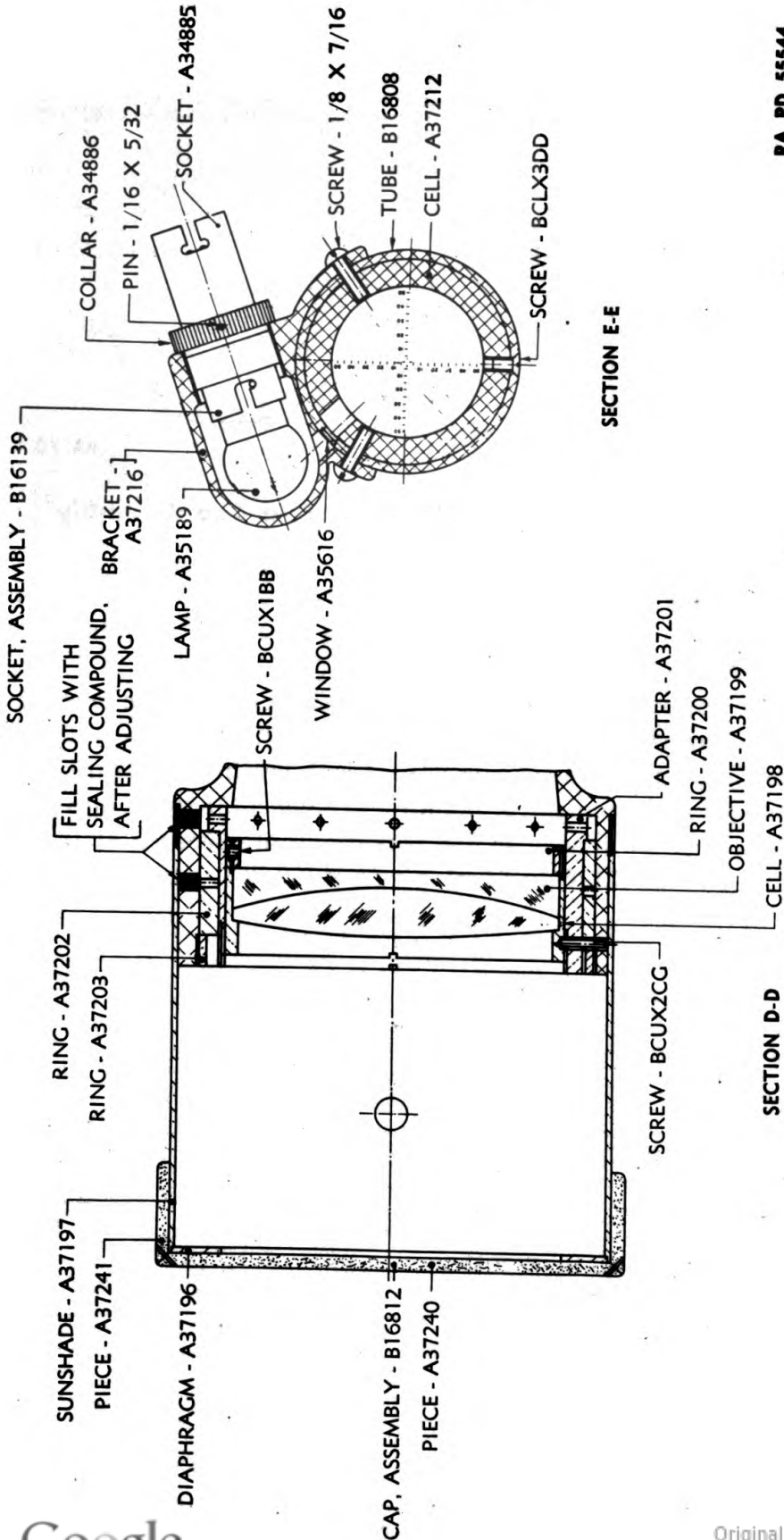


Figure 34—Telescope M3—Sectioned Views
(For Location Of Sections See Fig. 28)

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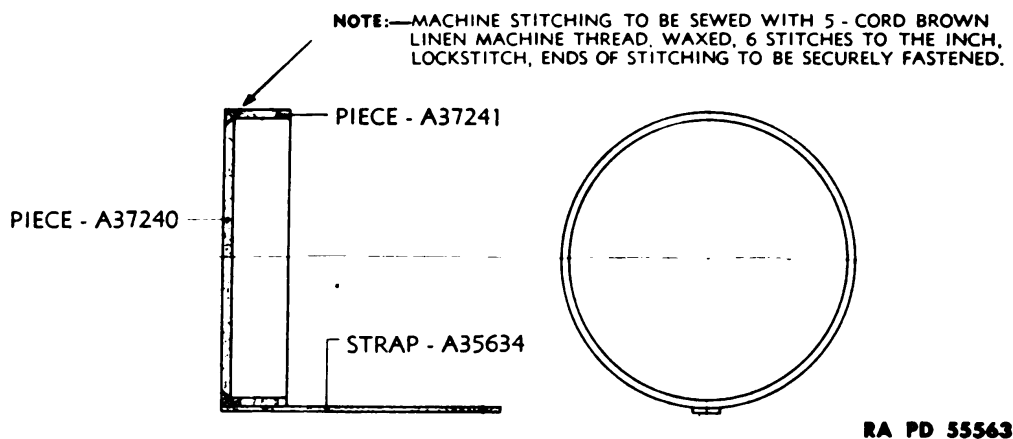


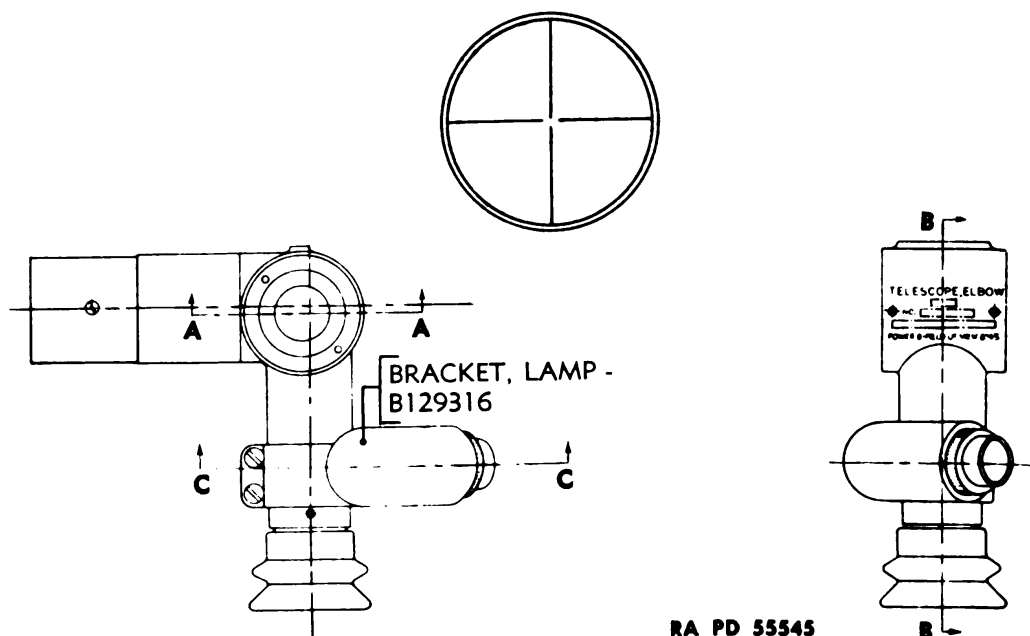
Figure 35—Telescope M3—Objective Cap Assembly

8. TYPE A TRIPOD.

a. The Type A Tripod (figs. 45 to 48, 110 to 114) consists essentially of a metal head C70128 and 3 telescoping wood leg assemblies C44593 with adjustable brace assemblies C70133 (fig. 48).

b. The tripod head has male threads which engage the leveling plate of the mount. A circular level assembly B129517 (figs. 110 to 112) mounted in the tripod head is used for rough leveling of the tripod before assembling the instrument. A plumb bob hook A135369 is also provided.

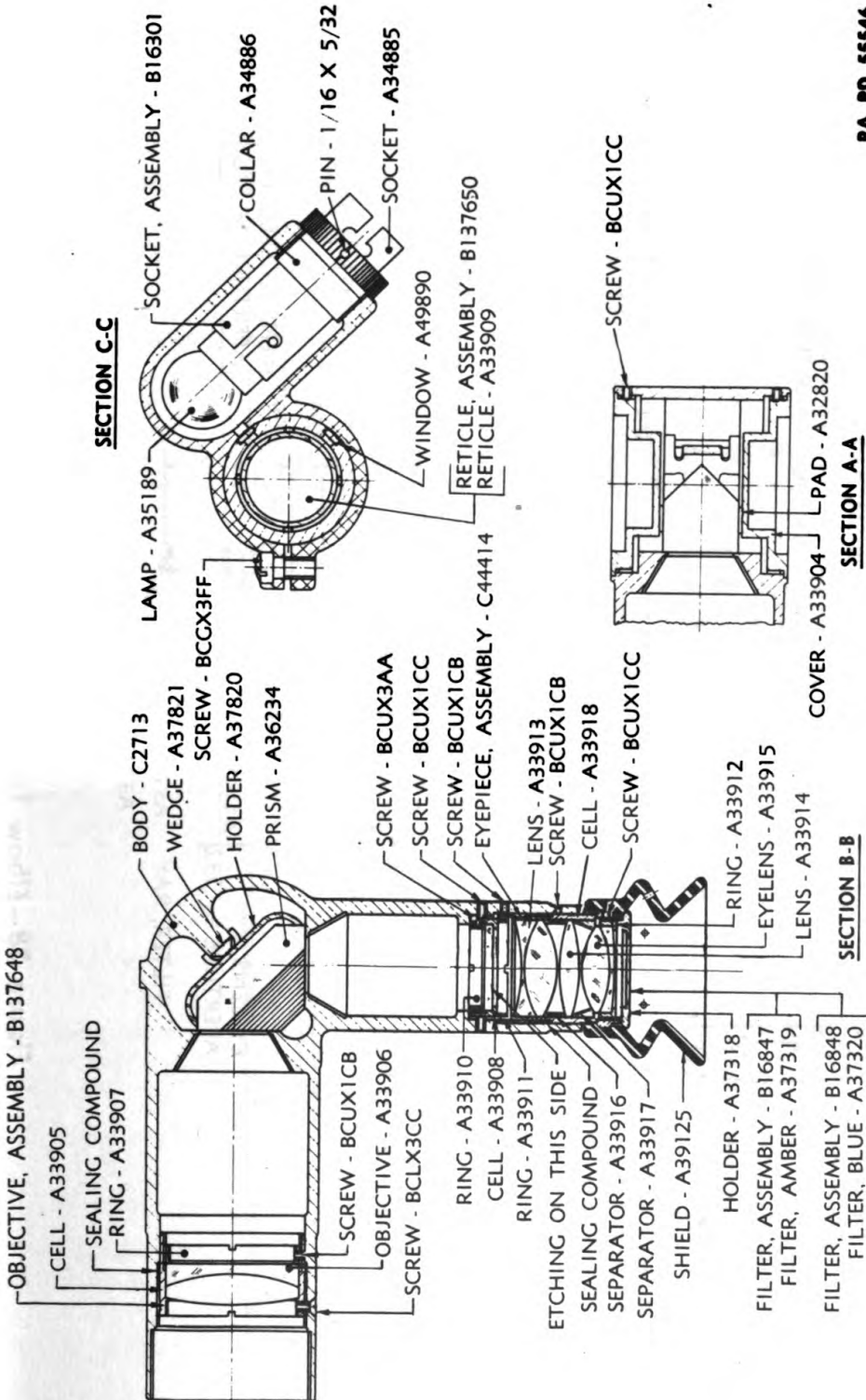
c. The legs are hinged to the tripod and are secured at the desired height by clamps X136C and wing nuts A38269.



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Figure 36—Elbow Telescope M2—Assembled Views And Reticle
(Sections A-A, B-B And C-C Shown In Fig. 37)

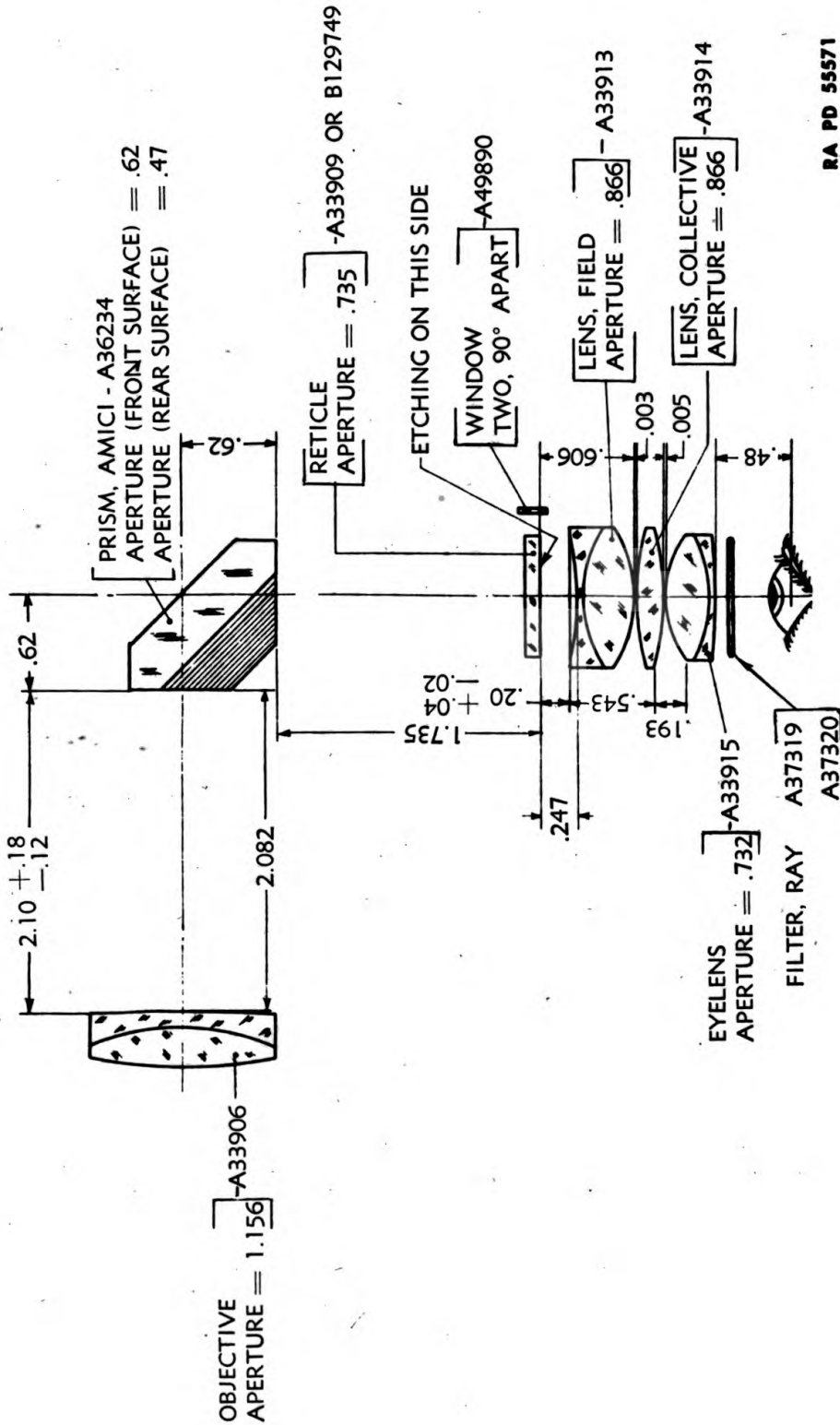
DESCRIPTION



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Figure 37 — Elbow Telescope M2 — Sectioned Views
 (For Location Of Sections See Fig. 36)

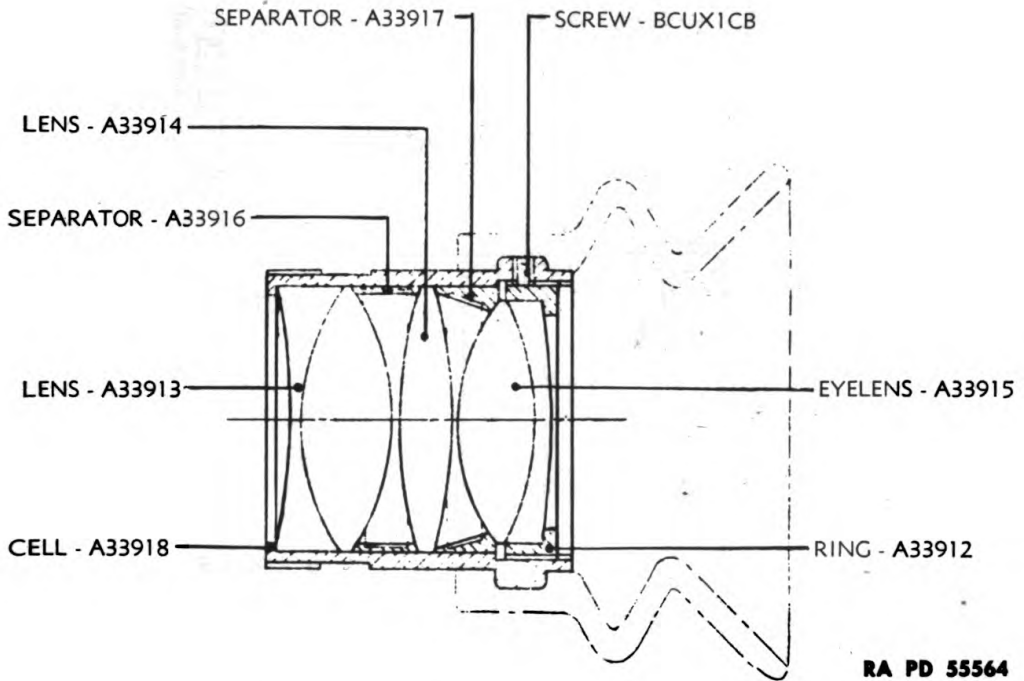
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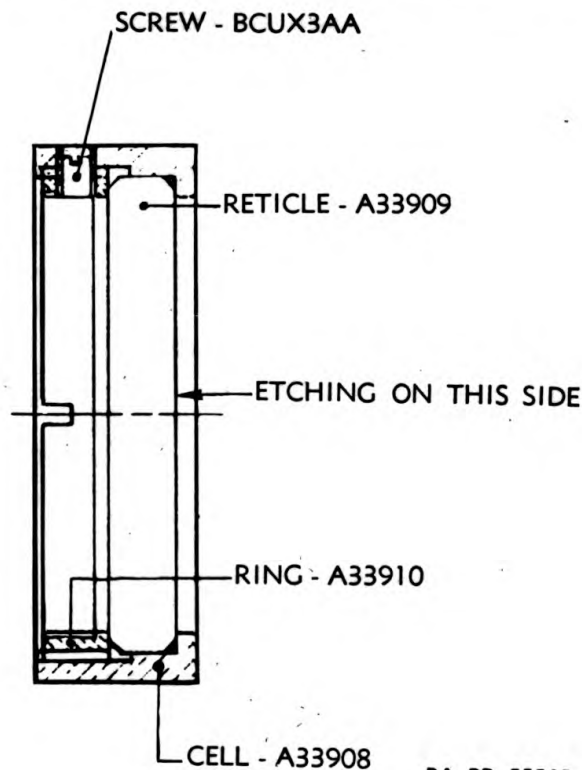
Figure 38—Elbow Telescope M2—Optical System

DESCRIPTION



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Figure 39—Elbow Telescope M2—Eyepiece Assembly



RA PD 55565

Figure 40—Elbow Telescope M2—Reticle Assembly

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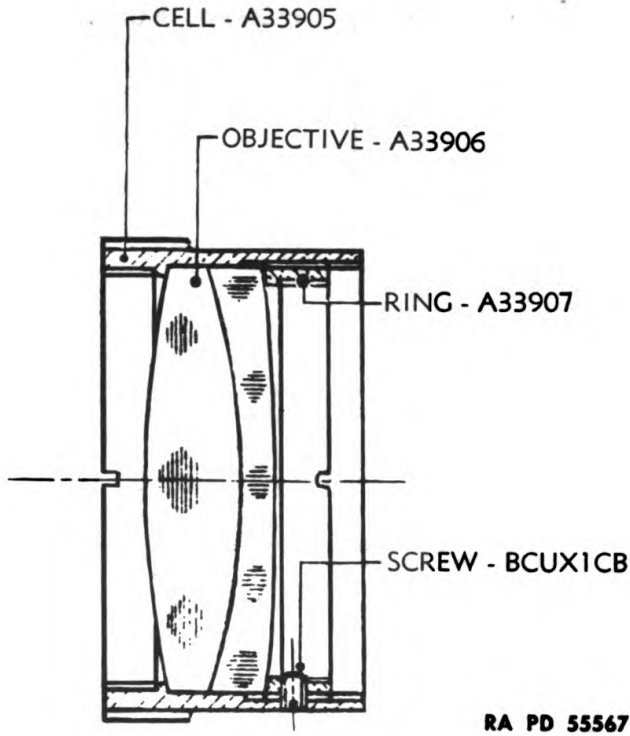
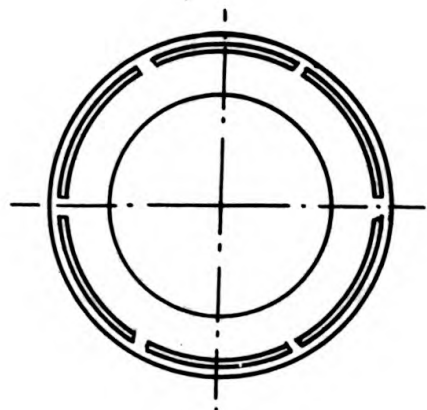
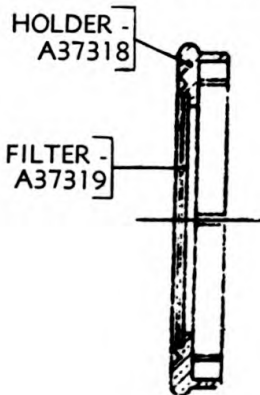


Figure 41—Elbow Telescope M2—Objective Assembly

- d. A carrying strap is provided (figs. 47 and 117).
- e. A cap is provided for protection of the male threads of the tripod head when the tripod is collapsed for carrying or storage.

9. OPERATION.

- a. In following the operating procedure, frequent reference should be made to the illustrations.



RA PD 55566

Figure 42—Elbow Telescope M2—Filter Assembly

DESCRIPTION

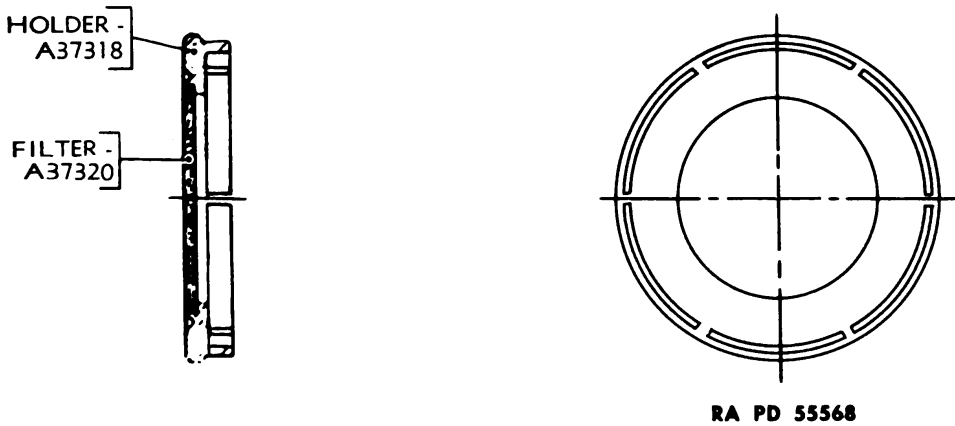


Figure 43—Elbow Telescope M2—Filter Assembly

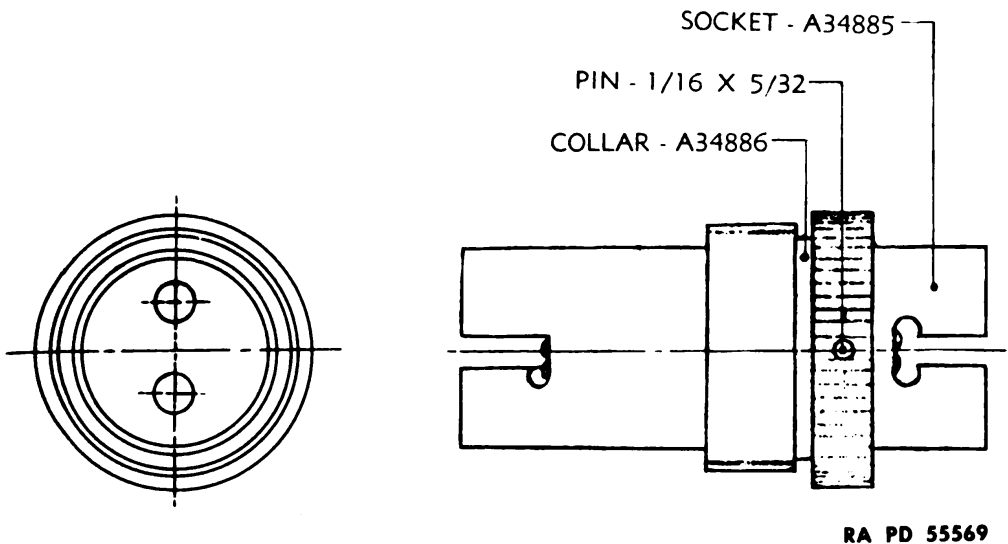


Figure 44—Elbow Telescope M2—Socket Assembly

(1) TO SET UP THE INSTRUMENT.

(a) Extend the tripod legs to the desired height, tighten the leg clamps, and embed the legs firmly in the ground. The legs should be spaced at least 2½ feet apart at the ground to insure stability. The tripod head is provided with a circular level, which should then be centered by readjusting the lengths of the legs as required.

(b) Pin the telescoping tube braces in place, adjusting their lengths with the clamping screws. Remove the cap B134574 from the tripod head.

(c) Remove the mount from its packing chest and screw the leveling plate B129179 carefully on the tripod head. Extreme care must be exercised at this point to insure that the threads engage properly. Approx-

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RA PD 55463

Figure 45—Type A Tripod

DESCRIPTION

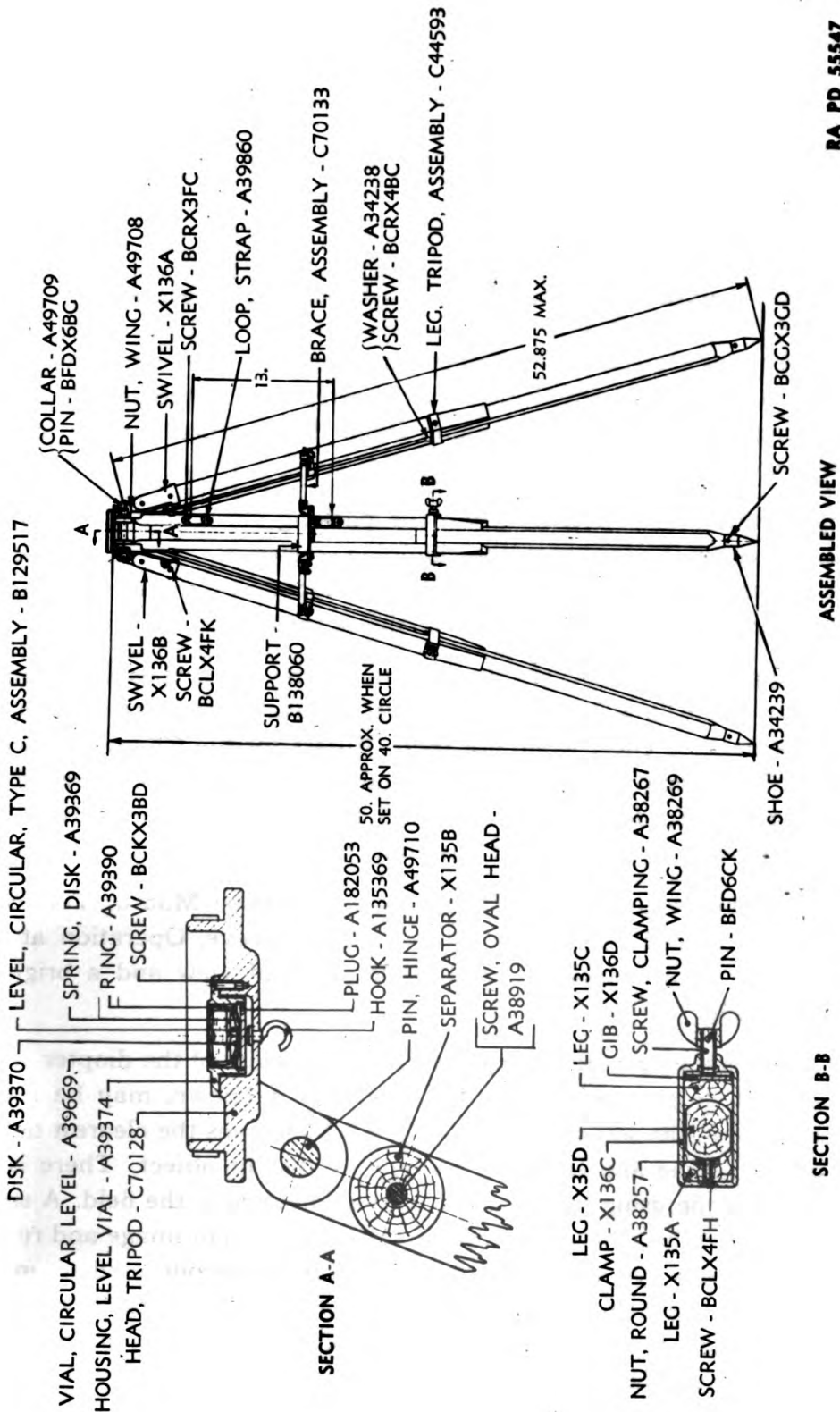
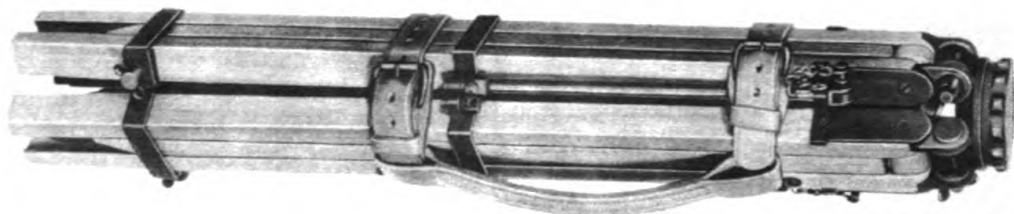


Figure 46—Type A Tripod—Assembled View

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SECTION B-B

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Figure 47—Type A Tripod—Traveling Position

mately 4 turns are required to mount this leveling plate securely, which plate should be rotated by using only the serrations on the periphery, not by turning other parts of the mount. Open the trunnion caps to receive the telescope trunnions.

(d) Remove the telescope from the packing chest and place on the mount, securing in place with the clamping screws. Be sure the telescope shaft extension is seated squarely in the V-shaped slot provided. Remove the leather cap from the objective of the telescope.

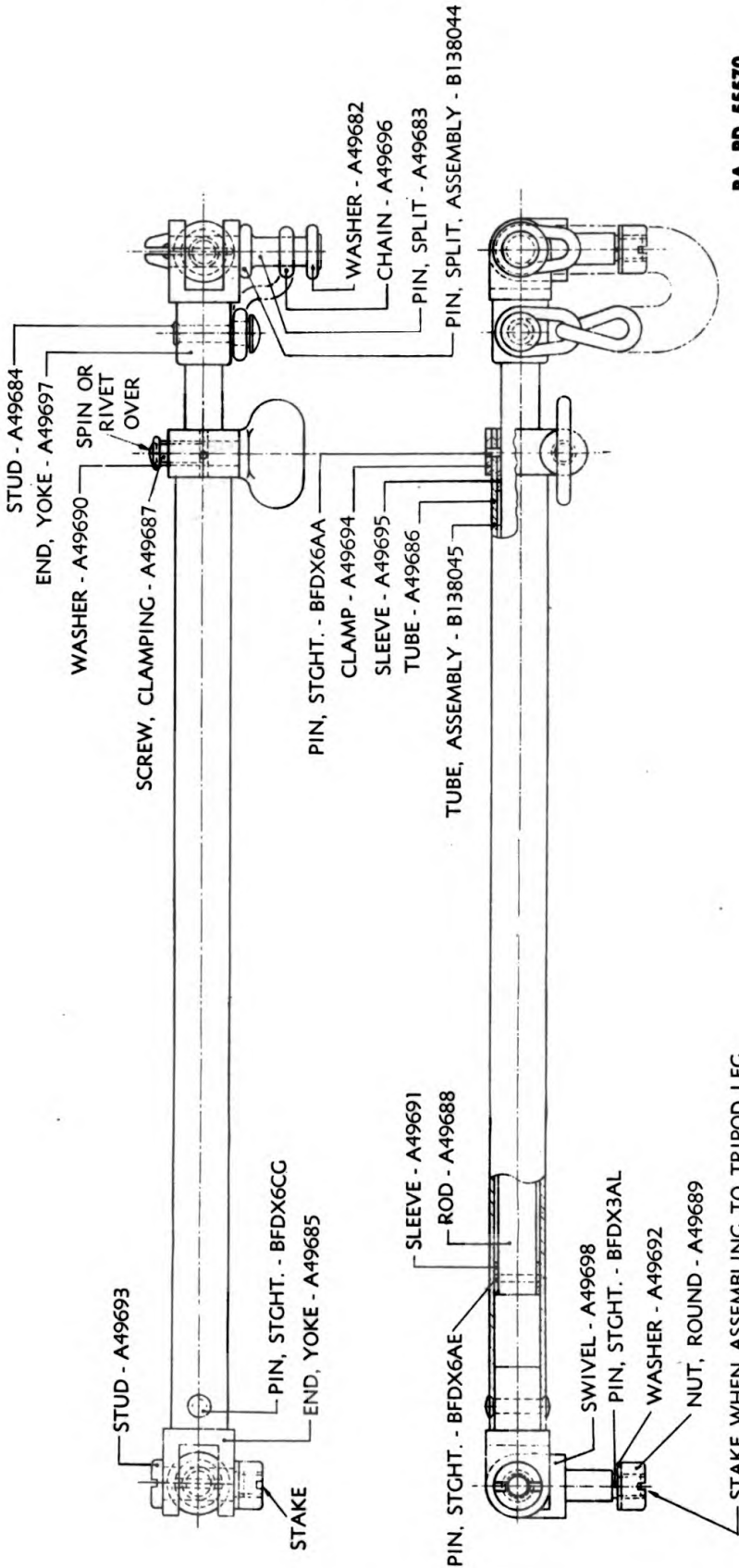
(e) Apply the amber or blue filters to the telescopes if required. Filters for the Elbow Telescope M2 are removable and are kept in the telescope packing chest when not used. Filters for the Elbow Telescope M35 or Telescope M3 are internal and are applied when needed by rotating the levers labeled "A" (amber) and "B" (blue) respectively, to their extreme counterclockwise positions.

(f) Set the magnification of the Elbow Telescope M35 or Telescope M3 to the desired power, using the focusing sleeve. Operation at the lower power is accompanied by a wider field of view and a brighter, steadier image.

(g) Focus the eyepiece, using the knurled portion of the diopter scale. The correct diopter setting for the observer, if known, may be set in directly; if not, the setting should be used which gives the clearest definition of the reticle and target or an equally distant object. There is no provision for the using service to focus the objective in the field. A small amount of parallax, that is, apparent relative motion of image and reticle as the observer's eye is shifted, may therefore be encountered when observing targets at distances other than that for which the factory adjustment was made; the angular errors so introduced, however, are not ordinarily sufficiently large to cause serious consequences in normal use.

(h) Make the necessary electrical connections if illumination is required. The plug attached to each of the various leads has a painted band

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Figure 48—Type A Tripod—Brace Assembly

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1/4-inch wide which serves to identify the plug for its particular use. The color code is as follows:

White	Azimuth scale lamp bracket
Green	Elevation scale lamp bracket
Yellow	Azimuth micrometer lamp bracket
Red	Rheostat bracket
Blue	Telescope M3 or Elbow Telescope M35, reticle lamp bracket
Not painted	Elbow Telescopes M2 and M2A1 brackets
Not painted	Plug to battery box

When connecting the lead wires, to avoid shorting the battery, connect first to the lamps, then to the battery. Adjust the illumination by means of the rheostat to a level such that both the target and the reticle graduations of the Telescope M3 may be seen satisfactorily (fig. 49).

(i) Level the mount, using the levels and the leveling screws A36371. Best results in performing this operation will be had with the mount oriented so that each level is parallel to a pair of diametrically opposite leveling screws; each level is then affected only by the corresponding pair of leveling screws. Tighten the leveling screws only until a snug contact is made.

(2) ORIENTATION.

(a) Set the thumbscrew A38254, clamped by the adjacent thumbscrew A38260, so that the slow motion azimuth arm B129177 is approximately in mid-position.

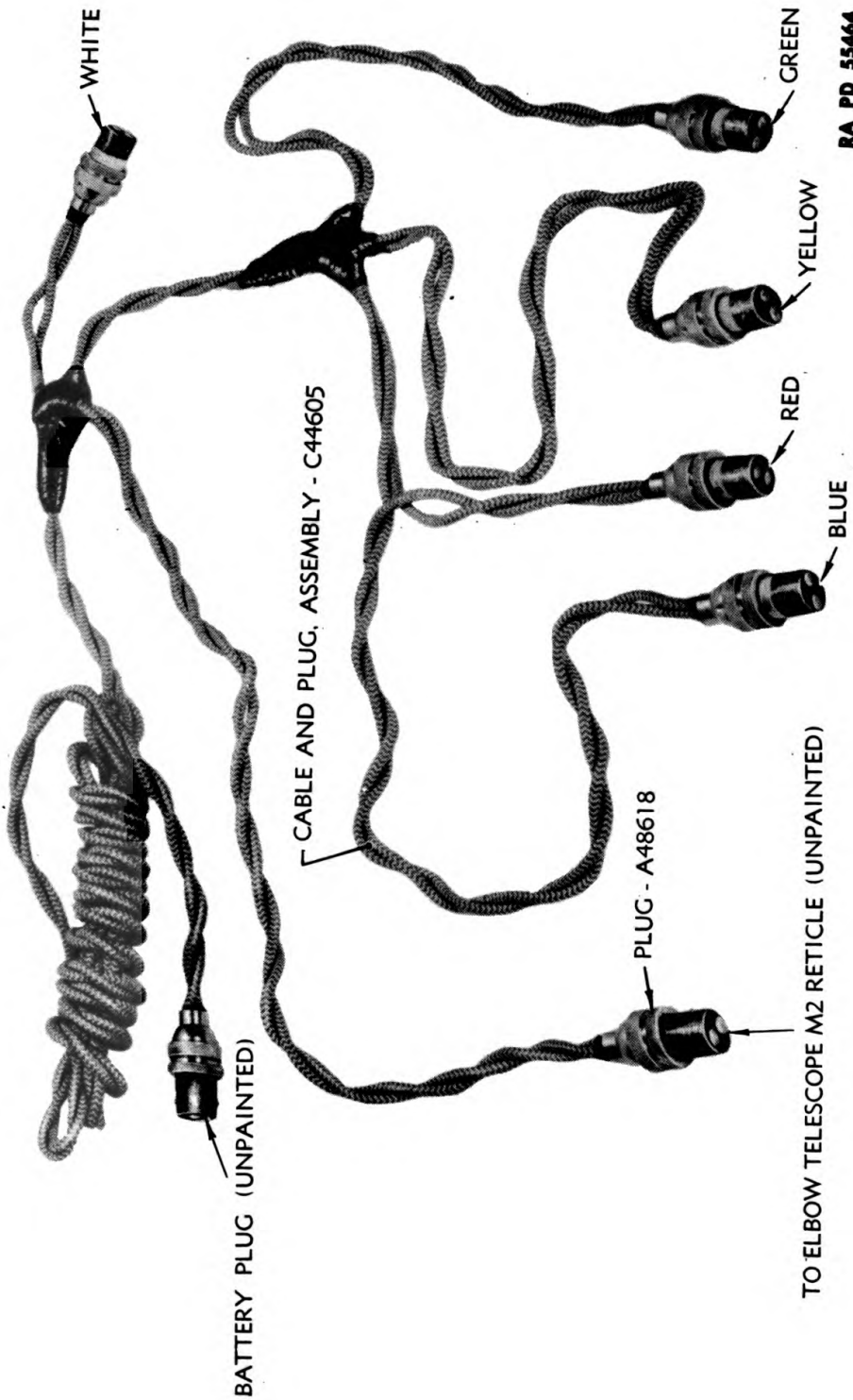
(b) If necessary, loosen the clamping screw A38251 (fig. 71) and rotate the yoke D9860 relative to the housing so that the azimuth and elevation worms are approximately parallel on the same side of the instrument. In this position, shown in figure 62, the crank A38245 is convenient to the right hand of the operator at the Elbow Telescope M2. Tighten the clamping screw. In some instruments the wiring plug, when inserted in the elevation scale lamp, limits the angle available for orientation by hitting the screw in one direction, or the azimuth scale lamp bracket in the other direction.

(c) Select a datum point of known azimuth and, by means of the crank, set the mount to indicate that azimuth on the scale seen through the reading window (coarse) and the micrometer (fine).

(d) Release the leveling screws A36371 and rotate the entire upper part of the mount so that the datum point appears approximately at the center of the reticle of the Elbow Telescope M35 or Telescope M3, elevating it as required by the knob. Take care not to unscrew the leveling plate B129179 from the tripod head. Level the instrument again and return to the azimuth setting of the datum point.

(e) With the thumbscrew A38254 unclamped by the thumbscrew

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Figure 49—Cable And Plug Assembly

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A38260, refine the setting described in step (d) above, so that the datum point appears exactly at the center of the reticle of the Telescope M3. If additional travel is required, the clamping screw may be loosened temporarily to permit moving the slow motion azimuth arm B129177 a small distance. It should be noted, however, that a large amount of motion at this point will result in a position of the crank A38245 inconvenient to the right hand of the operator. Were it not for this difficulty, this motion alone could be used for orientation purposes instead of loosening the leveling screws.

(f) Ascertain that the clamping thumbscrew, adjusting thumbscrew, and leveling screws are properly tightened. Once the instrument is properly oriented, these screws must not be disturbed. Verify the azimuth indication and the centering of the datum point on the reticle.

(3) COLLIMATION OF THE TWO TELESCOPES.

(a) Set up and level the instrument.

(b) On a convenient vertical surface normal to the line of sight, draw a horizontal line at the same height as the trunnions of the instrument. Mark off 2 points on this line, spaced the distance between the lines of sight of the 2 telescopes.

(c) Bring the battery commander's telescope to bear on the right-hand mark.

(d) Adjust the adapter of the observer's telescope to bear on the left-hand mark. Elevation adjustment is made by rotating the adapter on the shaft and reclamping. Azimuth adjustment is made by adjusting the spring-backed nut and bolt of the adapter.

(e) Adjust the elevation scale and micrometer at this point by setting the elevation scale index to zero after loosening its locking screws in elongated holes and by setting the micrometer to read zero after loosening the 3 clamp screws in the knob.

(f) Where a testing target is not available a distant aiming point may be used. The point selected may be a celestial body or some clearly defined terrestrial point well over 2,000 yards distant.

(4) OBSERVATIONS.

(a) It should be noted that, in the case of the Elbow Telescope M35, Telescope M3, and the Elbow Telescope M2 on this instrument, as the telescope is elevated the reticles are inclined correspondingly. Unless understood, this may cause confusion, particularly at elevations above 800 mils. It should be remembered that the axis of the reticle, which corresponds to the horizontal direction in the field of view, always remains parallel to the objective axis of the telescope (i.e., to the line of position). The axis corresponding to the vertical direction remains perpendicular

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(b) Motion of the instrument in azimuth is obtained by means of the crank A38245 and the indications are viewed on the scale below the reading window (coarse, 10-mil divisions) and on the micrometer (fine, $\frac{1}{10}$ -mil divisions). The crank may be disengaged, if desired, by pressing the lever to its limit of travel, permitting rapid rotation of the instrument in azimuth.

(c) Motion of the instrument in elevation (angular height) is obtained by means of the knob and the indications are viewed on the scale (coarse, 100-mil divisions) and on the micrometer (fine, 1-mil divisions).

(d) To observe deviations of trial shots, either at the battery or at the distant station position, and having made the preparations described above, carefully set the instrument to the azimuth and elevation (angular height) of the trial shot point. As each trial shot is fired, observe through the Elbow Telescope M35 or Telescope M3 the position of the bursts with respect to the mil graduations on the reticle. Announce the lateral and vertical deviations in mils from the center of the reticle as observed thereon.

(e) To follow the course of firing on a target, an observer in addition to the battery commander is required. The observer uses the Elbow Telescope M2 and operates the azimuth and elevation motions of the mount so that the target continuously appears at or close to the center of the reticle. The battery commander uses the Elbow Telescope M35 or Telescope M3 and observes the lateral and vertical deviations of the burst from the target.

(f) If desired, this instrument may be used to furnish indications of elevation and azimuth for orienting the entire battery in lieu of a surveyor's transit.

(g) The Elbow Telescope M35 and Telescope M3 are so designed that parallax between image and reticle is negligible for distances ordinarily encountered. However, for objects closer than 500 yards, parallax will exist. Sighting on such objects may be accomplished by placing before the objective a diaphragm of opaque material with a comparatively small circular opening.

(5) **REMOVAL FROM SERVICE.** To remove the instrument from service, disconnect the electrical connections (removing at battery first), place lead wire in compartment of battery box, place cover on the objective, remove the telescope and place in the chest provided, remove the mount from the tripod and place in the chest provided, screw cap on tripod head, fold tripod, and attach carrying strap.

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Section III

ACCESSORIES

	Paragraph
Accessories	10
Electrical equipment	11

10. ACCESSORIES.

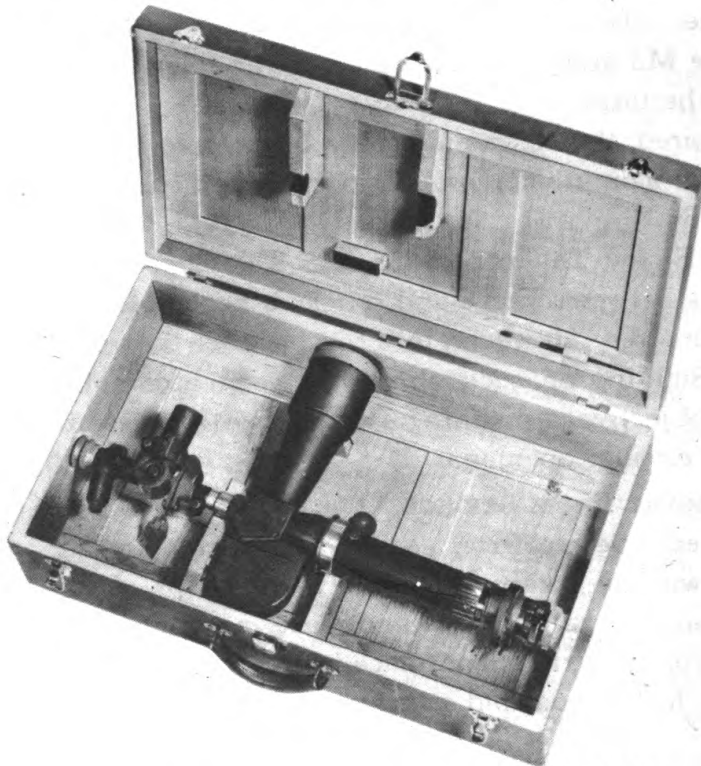
a. Packing Chest For Telescopes.

(1) This chest (fig. 50) is made of wood and contains blocking and padding to prevent shifting of the telescopes. The chest has a handle, a lock, and 2 keys.

(2) The chest contains the BRUSH, artist, camel's-hair, rd., in a leather strip in the lid of the chest. Two filters, amber and blue, for the Elbow Telescope M2 are held in pockets.

b. Packing Chest For Mount.

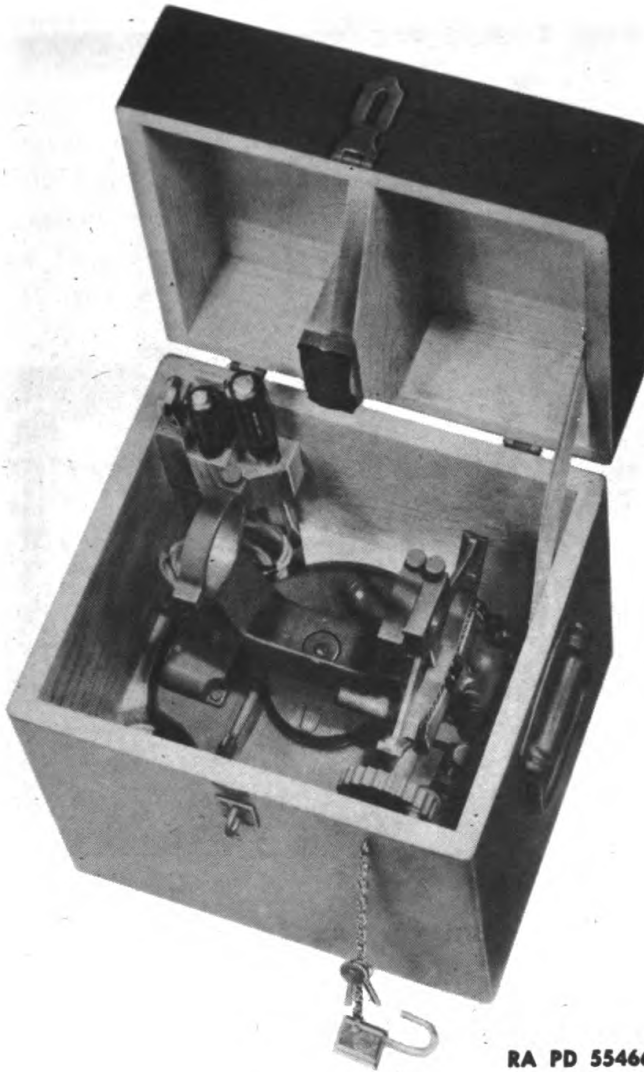
(1) This chest (fig. 51) is made of wood, and contains blocking and padding to prevent shifting of the mount of the instrument. The chest has 2 handles, a hasp and padlock, and 2 keys.



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Figure 50—Packing Chest For Telescopes

ACCESSORIES



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Figure 51—Packing Chest For Mount

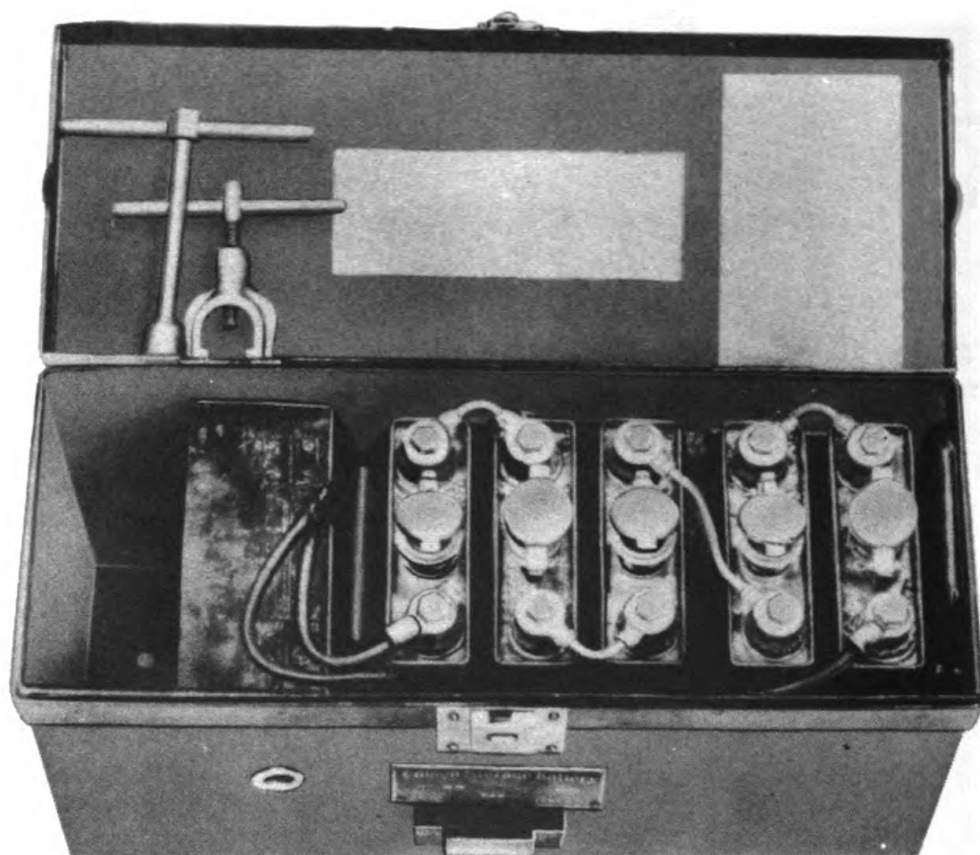
- (2) The chest contains the following accessories:
- (a) 2 screwdrivers
 - (b) 1 double-end wrench, $\frac{7}{16}$ -in. x $\frac{1}{2}$ -in.
 - (c) 1 oval sash brush
 - (d) 1 lead wire assembly

11. ELECTRICAL EQUIPMENT.

a. The electrical equipment furnished with this instrument consists of a battery box, battery, socket wrench, and disconnecting jack for terminal thereof, book of instructions for battery, lead wire for connection to the instrument, 7 spare lamps, and 2 double-end sockets.

(1) The battery box (fig. 52) (Edison B-4 type) is a metal box which houses the battery. It is fitted with 2 receptacles, internally con-

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Figure 52—Battery Box (Edison B-4 Type)

nected to the battery, either of which may be used to plug in the lead wire which connects to the instrument. A compartment is provided within the box for carrying the disconnecting jack, socket wrench, book of instructions, and 3 spare electric lamps.

(2) The battery is an Alkaline Storage Battery (Edison B-2 type) M1 consisting of 5 separate cells connected in series by connectors and supported in a wooden tray. The characteristics of the battery are listed below:

Rated capacity, ampere-hour	37.5
Number of cells, in series	5.
Discharge rate (8 hours), amperes	4.7
Discharge rate (5 hours), amperes	7.5
Average discharge voltage (8 hours)	1.24 (per cell)
Average discharge voltage (5 hours)	1.2 (per cell)
Normal charging rate (7 hours), amperes	7.5
Quantity of electrolyte, pounds	1.1 (per cell)
Total weight, pounds	29.

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(3) The book of instructions which accompanies each battery covers the care and preservation of the battery. The socket wrench and disconnecting jack are for removing the terminals from the terminal posts when necessary.

(4) The lead wire is provided to connect the various sockets of the instrument to the battery. It consists of several sections of twisted lamp cord properly connected, each section terminating in a double contact plug. All plugs, except the one which connects to the battery, have a painted band $\frac{1}{4}$ inch wide which serves to identify the plug for its particular use. For explanation of the colors see paragraph 9 a (1) (h). The connections are so arranged that the rheostat controls only the reticle lamp.

(5) Three spare lamps are carried in the battery box and 4 in the telescope carrying case. These lamps are of the type described in paragraph 4 a (6) (c).

b. Connect the electrical equipment to the instrument by inserting each lead wire plug into the corresponding colored socket and turning it until the bayonet pins hook into place. The battery plug of the lead wire should be connected last. Battery current may be conserved by disconnecting this plug whenever illumination is not actually required. The rheostat assembly, mounted on the azimuth housing of the instrument, controls the illumination of the telescope reticle. When disconnecting the electrical equipment from the instrument, the battery plugs should be removed first.

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Section IV

CARE AND PRESERVATION

	Paragraph
Cleaning and preserving materials	12
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Mount	14
Elbow telescopes	15
Electrical equipment	16

12. CLEANING AND PRESERVING MATERIALS.

a. Lubricants.

GREASE, lubricating, special, Ordnance Specification AXS-637 (for all lubrication where grease is required)

OIL, lubricating, for aircraft instruments and machine guns (for all lubrication where oil is required)

b. Cleaning Materials.

ALCOHOL, ethyl, grade 1

BRUSH, arist, camel's-hair, rd

PAPER, lens tissue (for cleaning lens, optical instruments, etc.)

SOAP, liquid, lens cleaning

SOLVENT, dry-cleaning (for cleaning metal components)

13. CARE IN HANDLING.

a. The instrument contains highly accurate mechanism, and the telescopes contain precise and delicate optical parts. Careful handling is imperative to avoid damage by unnecessary shocks, etc. When not in use, the telescopes and mount should be kept in the chests provided.

b. When sighting in the direction of the sun, the filter should be used to spare the observer's eye. The telescopes should not be pointed at the sun for any length of time since the rays concentrated at the reticle may loosen the balsam cementing the reticle lens.

c. Leveling and clamping screws must not be tightened beyond a snug contact. Excessive wear of threads and other damage to the instrument is thereby avoided.

d. The azimuth throwout lever must not be snapped into mesh. When disengaging the worm and worm gear, move the lever sufficiently to allow the teeth to clear. With this procedure excessive wear and burring of the teeth can be avoided.

CARE AND PRESERVATION

14. MOUNT.

a. Care In Handling.

- (1) When the mount is not set up on the tripod, it should be kept in the packing chest provided.
- (2) Avoid damage to the level vial graduations.
- (3) Mating surfaces should be wiped clean and then examined for nicks and burs before the telescopes, mount, and tripod are assembled.
- (4) Mechanisms should not be forced against the stops provided.

b. Lubrication.

- (1) The oil cup provided in the fork of the yoke is for lubrication of the yoke and spindle and is to be given a drop or two of oil every week.
- (2) The telescope bearing surfaces of the yoke and caps should be lightly greased or oiled when setting up the instrument.
- (3) The elevation worm is greased at assembly, and normally requires relubrication only at long intervals. The guides of the worm wheel segment should be given a thin film of grease and moved through entire range between stops to spread the grease over the sliding surfaces.
- (4) The oil cup on the hub at the lower end of the yoke is for the lubrication of the azimuth slow-motion arm. A drop of oil every 2 weeks should be sufficient. The thumbscrews and plunger mechanism associated with the azimuth slow-motion arm should be lightly but thoroughly greased. These parts should be moved through their entire range of motion to spread the lubricant thoroughly.
- (5) The azimuth worm mechanism and throwout lever is greased at assembly and normally requires relubrication only at long intervals.
- (6) The 4 leveling screws should be lightly greased at long intervals and run in and out of the azimuth worm wheel to spread a thin film of grease throughout the thread. The leveling ball should be lightly greased at the same time. Coat the female thread with a thin film of grease for protection when the mount is off the tripod.
- (7) Knob handles should be given a drop or two of oil about once a month.
- (8) Excess lubricant should be removed to prevent accumulation of dust and dirt.
- (9) The felt strip in the periphery of the worm gear should be oiled about once a month. The felt should not be allowed to dry out as this will allow the entry of dust, etc.

15. ELBOW TELESCOPES.

- a. To obtain satisfactory vision, it is necessary to keep the exposed surfaces of the lenses and other parts clean and dry. Corrosion and etching of the glass surfaces can thus be prevented or retarded.

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b. Moisture due to condensation may collect on the optical parts of the instrument when the temperature of the instrument is below that of the surrounding air. This may be removed by placing the instrument in a warm place. Heat from strongly concentrated sources should not be applied directly, as it may cause unequal expansion of parts with resulting inaccuracies in observation.

c. For dusting optical parts use only a clean camel's-hair brush. For wiping, use only lens paper which is prepared for cleaning optical glass.

d. To remove oil or grease from optical surfaces, apply ethyl alcohol or liquid lens cleaning soap with clean lens tissue and wipe dry with clean, dry lens tissue. If the soap or alcohol is not available, breathe on the glass and wipe dry with clean lens tissue; repeat this operation until the glass is clean.

e. To remove dust, brush the glass lightly with a clean camel's-hair brush, and rap the brush against a hard body in order to knock out dust particles clinging to the hairs. Repeat until dust is removed.

f. Do not wipe lenses or windows with the fingers.

16. ELECTRICAL EQUIPMENT.

a. The book of instructions which accompanies each battery covers the care and preservation of the battery.

b. When disconnecting the electrical equipment from the instrument the battery plug should be removed first.

c. Electric lead wires should be handled carefully and should not be pulled when breaking connections.

d. Burned out lamps should be replaced. Spare lamps are carried in the battery box.

Section V

INSPECTION

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Tolerances	18
Inspection requirements	19
Tools and facilities for basic inspection and repair	20
Basic inspection of Type A Tripod	21
Basic inspection of mount	22
Basic inspection of elbow telescopes	23
Basic inspection of observation instrument	24
Action to be taken	25

17. PURPOSE.

a. Inspection is vital. Thorough, systematic inspection at regular intervals is the best insurance against an unexpected breakdown at the critical moment when maximum performance is absolutely necessary.

b. Inspection is for the purpose of determining the condition of the instrument, whether repairs or adjustments are required, and the action necessary to place the instrument in serviceable condition.

c. The basic inspection is a preliminary search to determine the condition of the instrument and to locate basic faults. Proper disposition of the instrument can then be made and necessary action taken or recommended. Inspection forms (O.O.F. 7228 and O.O.F. 7229, fig. 53) are provided for recording the results of the inspection. Instructions concerning the entries to be made are printed on the back of the forms.

d. The detailed inspection and correction described in the maintenance and repair section of this manual are performed by the instrument repairman. With these instructions he puts the instrument in serviceable condition. The procedure may vary with each instrument, depending on the faults indicated by the basic inspection. Inspection forms and methods used in connection with the detailed inspection are described in TM 9-2602, "Instruction Guide Instrument Repairman."

18. TOLERANCES.

a. Tolerances, or allowable errors, are specified where necessary to indicate the degree of accuracy required in performing certain adjustments. In general, an instrument is considered unserviceable if the error in any part exceeds the specified tolerance. However, it must be realized that the specified tolerance is intended to serve mainly as a guide for the

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inspector, and must be supplemented by the inspector's judgment. Even if the tolerances are within satisfactory limits, the repairman should attempt to reduce the errors if time and conditions permit.

19. INSPECTION REQUIREMENTS.

a. The tripod should be checked for:

- (1) Completeness.
- (2) Appearance.
- (3) Condition of thread and mating surface for mount.
- (4) Condition of legs contracted and extended.

b. The mount should be checked for:

- (1) Name plate data.
- (2) Completeness.
- (3) Appearance.
- (4) Condition of paint.
- (5) Condition of machined locating surfaces on yoke, elevation scale segment, and leveling plate.
- (6) Smoothness of operation of worm motions (elevation worm, azimuth worm).

(7) Action of clamps.

c. Elbow telescopes should be checked for:

- (1) Name plate data.
- (2) Completeness.
- (3) Appearance.
- (4) Sealing.
- (5) Condition of paint.
- (6) Condition of machined locating surfaces.
- (7) Operation of filters.
- (8) Definition.
- (9) Reticle alinement.
- (10) Collimation.
- (11) Focus of eyepiece.
- (12) Focus of objective (parallax).

20. TOOLS AND FACILITIES FOR BASIC INSPECTION AND REPAIR.

a. An instrument repair kit containing common tools and supplies for instrument inspection and repair is furnished to ordnance maintenance companies. (This KIT, repair, instrument, replaces kits previously issued as KIT, repair, optical, for field artillery, and KIT, repair, optical, for Harbor Defense.) Most of the items in the kit, such as screwdrivers, etc., require no description, as their uses are self-explanatory. The collimating telescope which is furnished with the kit is a small pre-focused

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telescope of cylindrical shape. It is used for inspecting the optics of a telescope and for setting up test fixtures. The collimating telescope does not require adjustment in use, and is not to be disassembled in the field.

b. The basic inspection can be made with only a few common hand tools, but it will be facilitated if the following are available:

- (1) Sturdy work bench, affording clear vision to the front.
- (2) Collimating telescope.
- (3) V-block for elbow telescopes.
- (4) Common hand tools (screwdriver, wrenches, etc.).

c. Additional tools and facilities are listed in paragraph 27. These are used in detailed inspection and correction.

21. BASIC INSPECTION OF TYPE A TRIPOD.

a. Examine the tripod for completeness, appearance, and for broken or bent parts.

b. Extend the legs and check for smooth working of legs, wing nuts, clamps, etc.

c. Remove the serrated cap on the head, and examine the thread and mating surface. The circular level should be secure and unbroken.

d. If the tripod is serviceable, set it up and level it. See paragraph 9 a (1).

e. The carrying strap should be in good condition.

22. BASIC INSPECTION OF MOUNT.

a. Record instrument serial number from name plate. The name plate is located on the side of the housing and adjacent to the azimuth micrometer.

b. Examine the mount for completeness, appearance, condition of paint, and for broken or bent parts.

c. Machined mating surfaces on the mount should be clean and free of nicks or burs.

d. The 2 level vials should be secure in their housings and unbroken.

e. Scale, micrometer, and index graduations should be legible.

f. Secure the mount on the tripod. See paragraph 9 a (1).

23. BASIC INSPECTION OF ELBOW TELESCOPES.

a. Record serial number from name plate on each telescope.

b. Examine the telescopes for completeness, appearance, condition of

INSPECTION

paint, and for broken or bent parts. The open sight should be undamaged and secure. Basic inspection of the optics can best be made with the telescopes assembled to the mount and tripod.

c. Machined mating surfaces on the telescopes should be clean and free of nicks or burs.

d. Check condition of eyeshield.

e. Secure the telescopes to the mount. See paragraph 9 a (1).

24. BASIC INSPECTION OF OBSERVATION INSTRUMENT.

a. Turn the azimuth knob until the housing and yoke have rotated through 360 degrees. Note any stiffness, binding, or excessive play. Backlash should not exceed 0.5 mil.

b. Loosen the clamping screw of the azimuth slow-motion arm and turn the yoke with respect to the housing. Note stiffness, binding, or excessive play.

c. Turn the elevation knobs to move the telescopes through the entire range of the elevation scale. Note any stiffness, binding, or excessive play.

d. Check the condition of the battery as indicated in the book of instructions which is contained in the battery box. Connect the electrical equipment to the instrument as described in paragraph 9 a (1) (h) above. Switch on all the lights. Note any burned-out lamps. Tap each lamp socket and flex the loose cables. Flickering of any of the lamps indicates a possible loose connection or broken wire. Test the rheostat by turning knob, and noting dimming and brightening of reticle lamps. Leads should have secure fittings and should not be frayed. Identifying color bands and spots should not be obscured.

e. Test the setting of the level vials with the instrument set up as indicated in paragraph 9 a (1) by turning the housing slowly through one complete turn in azimuth. If either bubble departs from its center position, adjustment is required either in orientation or in the setting of the level vials.

f. Look through each telescope and examine the optical elements for signs of breakage, dirt, grease, moisture, and deterioration of adhesive balsam in the compound lenses. Defects can best be examined with the aid of the collimating telescope. The image should appear sharp and clear and the reticle should be in sharp focus. When observing a distant object there should be no relative movement (parallax) between the object and the reticle as the eye is moved slightly from side to side or

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up and down. Image and reticle pattern should both be upright when the telescope is in normal operating position.

g. Test the settings of the elevation scale and micrometer with the instrument level and the telescope horizontal. At this position, the elevation scale and micrometer should indicate zero. At any graduation of each scale the corresponding micrometer should be exactly alined with its index.

(1) The horizontal position of the telescope for this setting may be determined by sighting on a distant point at the same height. This point may be determined by using a level or other instrument of known accuracy.

(2) If more convenient, this adjustment may be performed using a datum point of known elevation or angular height. The elevation scale and micrometer should read accordingly.

h. The horizontal and vertical alinement of the reticle cross lines of the Elbow Telescope M35, Telescope M3, or Elbow Telescope M2 may be checked by sighting on a vertical line such as a plumb line with the instrument level.

i. The vertical travel may be checked with the instrument leveled, and with the telescope mounted in place. The line of sight of the telescope should not deviate more than 0.5 mil from a true vertical line when the telescope is rotated in the trunnion bearings from 0 to 800 mils and not more than 0.75 mil when elevated to 1500 mils.

j. Parallelism of the objective axes may be checked by sighting on a distant target (preferably a celestial body) with both telescopes.

k. The open sight should be alined with the optical line of sight of the telescope to within approximately 5 mils.

l. Check the eyepieces, using the collimating telescope, for sharpness and clarity of definition. In the case of the Elbow Telescopes M3 or M35, at the optimum setting of the eyepiece the diopter scale should read zero.

25. ACTION TO BE TAKEN.

a. Instruments found defective must be repaired or adjusted to render them serviceable. Defects noted and action to be taken must be entered on the inspection form for each instrument. The action to be taken will be governed by the facilities available. If the facilities of the section do not permit satisfactory repair or adjustment, pass the unserviceable components on to a higher maintenance echelon and issue replacement items to the using arms.

Section VI

MAINTENANCE AND REPAIR

	Paragraph
General	26
Tools and facilities for detailed inspection, maintenance, and repair	27
Test and adjustment of level vials	28
Removal of backlash	29
Correction of faulty definition	30
Test for plumb travel (correct vertical travel)	31
Test for horizontal travel	32
Test and adjustment of variable power mechanism (elbow telescope M35 only)	33
Test and adjustment for parallax	34

26. GENERAL.

a. The repairman will use only the portions of the following instructions that are indicated by the results of his preliminary inspection.

b. Correction for defects in the telescope mount is made primarily by replacement of worn or broken parts. The necessary disassembly and assembly is described in section VII.

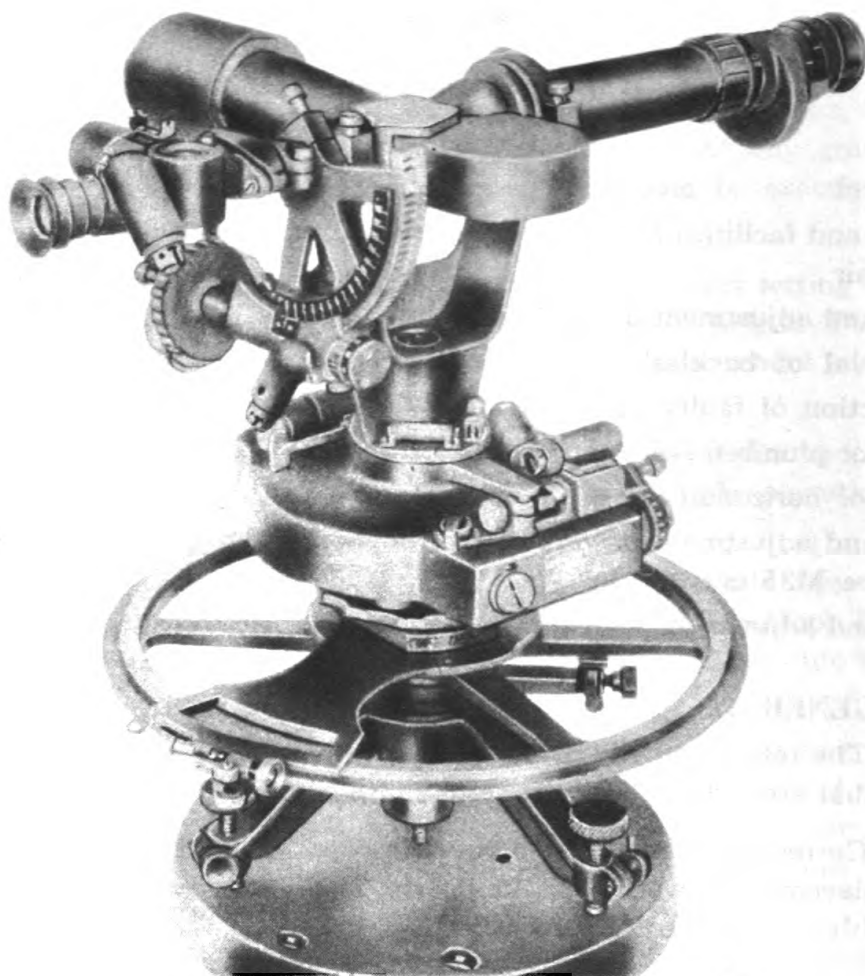
c. Correction for defects in the elbow telescope is made primarily by replacement of damaged or broken optical parts or adjustment of the optical parts. Repairs involving replacement of the telescope body should be performed only at an arsenal or base shop.

27. TOOLS AND FACILITIES FOR DETAILED INSPECTION, MAINTENANCE, AND REPAIR.

a. Testing instruments, fixtures, and adapters are carried in the Instrument Repair Truck M1. Most of those listed below are carried in the truck and will facilitate the detailed inspection, maintenance, and repair of this instrument. The target (fig. 56) may be improvised.

- (1) Azimuth testing fixture (fig. 54).
- (2) Elevation testing fixture (fig. 55).
- (3) Adapter (fig. 57).
- (4) Collimating telescope (fig. 57).
- (5) Sensitive bench level (fig. 57).
- (6) Target (fig. 56).

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Figure 54—A.A. B.C. Observation Instrument M1 On Azimuth Testing Fixture

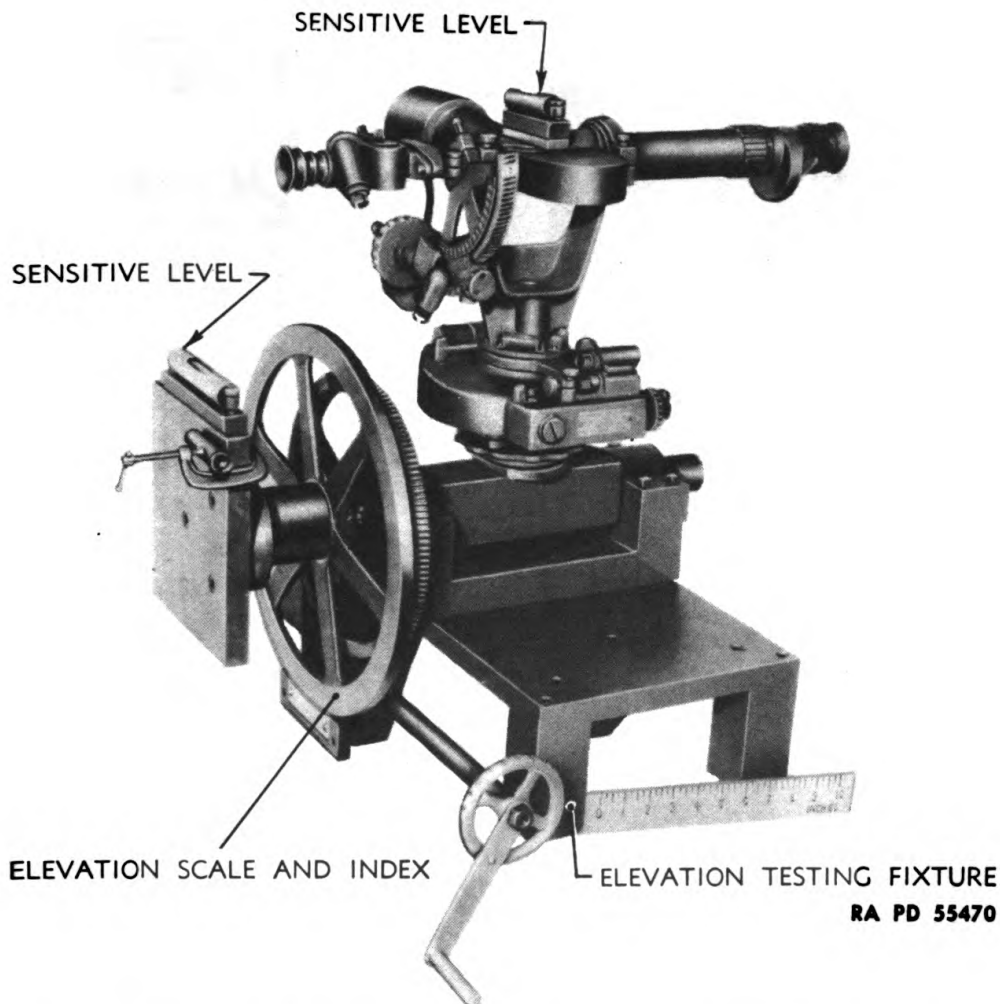
28. TEST AND ADJUSTMENT OF LEVEL VIALS.

a. This test and adjustment may be made with the instrument mounted on its own tripod or, where further adjustments of the instrument have been indicated in the basic inspection, mounted on the azimuth testing fixture (fig. 54).

b. Level the instrument on the Type A Tripod and observe the level bubbles as the instrument is rotated slowly in azimuth. If the bubbles remain central, the levels are in correct adjustment. If one or both bubbles move, the following adjustment is to be made:

(1) Set the level to be adjusted parallel to a pair of diagonally opposite leveling screws and adjust the pair until the bubble is central.

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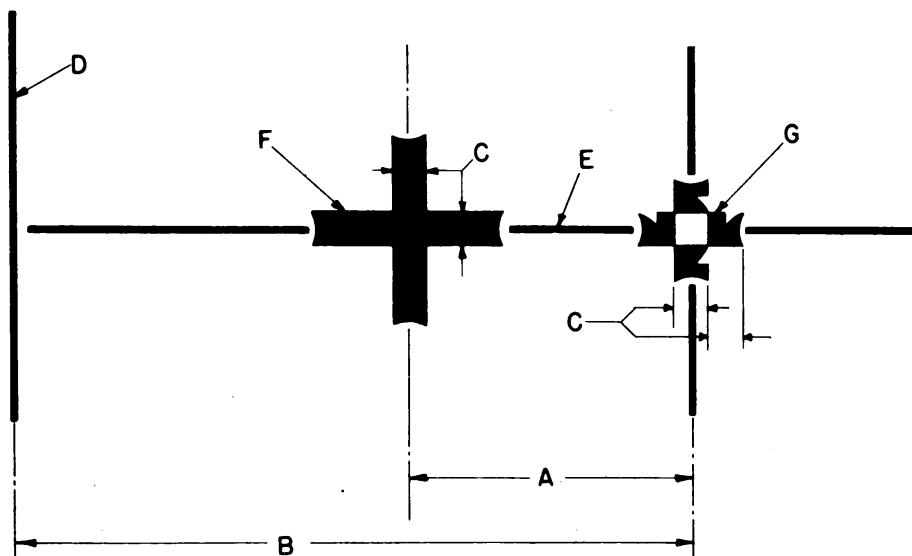
Figure 55—A.A. B.C. Observation Instrument M1 On Elevating Testing Fixture

- (2) Turn the instrument 180 degrees in azimuth.
- (3) Turn the level adjusting screws to return the level bubble *halfway* to its original position.
- (4) Relevel the instrument, rotate it 180 degrees and again note the position of the bubbles. Repeat the operation if necessary, until the best possible adjustment is obtained.

29. REMOVAL OF BACKLASH.

a. To remove backlash from the azimuth and elevation worm drives, it is necessary to take up on the caps in which rotate the ball-joints of the worms. Refer to paragraph 36 for the disassembly necessary for access to the caps. Check the plugs and springs by working the shaft

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A = DISTANCE BETWEEN \odot OF TELESCOPE, M3 AND \odot OF ELBOW TELESCOPE, M2 LESS ALLOWANCE FOR TARGET DISTANCE. FOR EXAMPLE: AT 3500 YARDS $A=0$ AND A SINGLE TARGET WOULD BE USED (SEE TELES., M3 SPEC.). AT 32 YARDS, THE DISTANCE USED AT FRANKFORD ARSENAL, $A = \odot$ TO \odot DISTANCE LESS $\frac{32}{3500}$ OF \odot TO \odot DISTANCE.

B = DISTANCE FROM \odot OF TELESCOPE, M3 TO \odot OF COLLIMATING TELESCOPE (SEE FIG. 7).

C = 1 MIL.

D = LINE WHICH COLLIMATING TELESCOPE LINE OF SIGHT SHOULD INTERSECT IN ORIENTING TARGET.

E = LEVEL LINE.

F = TARGET FOR ELBOW TELESCOPE, M2

G = TARGET FOR TELESCOPE, M3

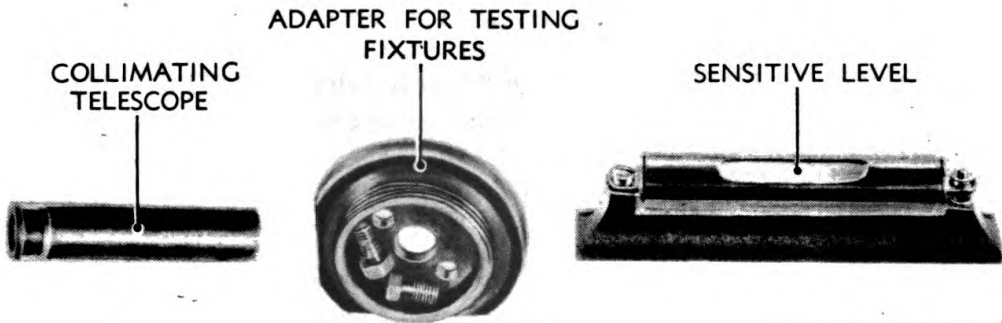
PA PD 55471

Figure 56—Testing Target

against the spring. Remove the plugs if necessary for access to the springs; then replace.

b. Tighten the cap with a spanner wrench, clamp it with its locking screws, and operate the worm through the entire range of motion, checking for binding or backlash.

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RA PD 55472

Figure 57—Instruments For Inspection

30. CORRECTION OF FAULTY DEFINITION.

a. The basic inspection (par. 24) may indicate poor definition. Examination, facilitated by the use of a collimating telescope, may indicate the cause to be the accumulation of dirt, grease, moisture, film, or bacteria growth on the optical elements. Other causes may be scratching or breakage of the optical elements, or deterioration of the adhesive balsam in the compound lenses. Where these defects are observed, it will be necessary to disassemble the instrument sufficiently to remove the faulty optical element for cleaning or replacement. Disassembly is described in section VII.

b. Where the basic inspection indicates that the error is caused by incorrect adjustment of the optical elements, it will be necessary to adjust the elements at fault.

(1) Where parallax is present, adjust the objective as described in paragraph 34.

(2) In the case of the Elbow Telescope M35, where the reticle does not appear sharp (with the diopter scale at the observer's setting), throughout the change in magnification from 10 to 20 power, adjust the erecting lenses as described in paragraph 33.

31. TEST FOR PLUMB TRAVEL (CORRECT VERTICAL TRAVEL).

a. Set up the elevation fixture (fig. 55) so that a fairly distant target may be located. Level the fixture by placing the sensitive bench level parallel to the axis of rotation and then 90 degrees to the axis. Adjust the fixture until the level indicates level in both directions. Set the elevation scale index to read zero.

b. Attach the threaded adapter (fig. 57) to the testing fixture and screw the mount to the adapter. Secure the telescopes to the mount. Level

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the instrument by adjusting the thumbscrews of the leveling plate until the level vials of the mount indicate level.

c. Locate the target with the collimating telescope. The collimating surface on the end of the fixture is used to locate the target in azimuth. The surface used originally to level the fixture in the direction of the target is used to locate the target at the proper level. The target is at the proper level when the horizontal axis of the target is in the same horizontal plane as the line of sight of the Telescope M3 when the line of sight is horizontal. The target is properly located in azimuth when the vertical axis of the target is vertical and at the proper parallel distance from the plane of the collimating surface at the end of the testing fixture.

d. Set the elevation scale and micrometer of the instrument to zero elevation. Turn the azimuth scale and micrometer to zero and, releasing the slow-motion clamp, swing the mount in azimuth until the vertical line of the Telescope M3 or Elbow Telescope M35 aligns with the target.

e. Turn the handwheel of the fixture to depress the line of sight about 200 or 400 mils. Turn the elevation micrometer a like amount to bring the telescope line of sight to a horizontal plane slightly below the original setting. If the fixture is accurately set up and if the telescope reticle moves to the right or left of the vertical target line, then either the optical axis is not at right angles to the telescope trunnions, or the axis of telescope trunnions is out of level when the fixture and the instrument are properly leveled.

f. To determine which of these 2 errors is present, set up a collimating telescope a short distance away, in the optical path of the Telescope M3 or Elbow Telescope M35. The crosslines of the reticle pattern should center exactly on the collimating telescope. Lift the Telescope M3 or the Elbow Telescope M35 from its seat. This should be done by disengaging the clamping thumbscrews and care should be taken to avoid shifting the mount. Set up a target or aiming point a short distance from the instrument. The point should be in the optical path of the collimating telescope and on the opposite side of the instrument from the collimating telescope. Carefully return the Telescope M3 or the Elbow Telescope M35 to its seat but revolved from its former position 180 degrees. Do not engage the elevation segment. A level may be laid on the prism seat to check the rotation. In this new position, the Telescope M3 or the Elbow Telescope M35 should be exactly aligned on the target or the aiming point. If any deflection in azimuth of the telescope crosslines from the aiming point is observed through the Telescope M3 or the Observation Telescope M35, the objective axis is not perpendicular to the eye-

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piece axis. The deflection indicated in the field of view is double the actual error, and adjustment of the objective eccentrics should be made as described in subparagraph g below. If this test indicates that the objective axis is perpendicular to the eyepiece axis, then the error found in subparagraph e above, is caused by error in the axis of trunnions and the instrument should be sent to a base shop.

g. If the test indicates that the objective is out of perpendicular, move the objective cell in the direction of the target in the field of view, by rotating the eccentric objective cell in one direction and the eccentric sleeve in the other direction (fig. 58) or by holding one eccentric and rotating the other through a short angle. Two slots, covered by the sunshade and filled with sealing compound, offer access to holes in the circumferences of the cell and sleeve. Two pins or sticks may be used for adjustment. Repeat the test given above noting whether the telescope appears to follow the line. Continue the procedure in the same direction or in the reverse direction as indicated by repetitions of the test until perpendicularity is obtained.

32. TEST FOR HORIZONTAL TRAVEL.

a. Place the instrument on the azimuth testing fixture and level both the fixture and the instrument. Set the instrument to zero mils elevation and sight carefully on a testing target. Revolve the testing fixture 360 degrees in one direction and the instrument, by rotation of the azimuth worm mechanism, 360 degrees in the opposite direction simultaneously. Take readings at 45-degree intervals. If the line of sight deviates above or below the point on the target, the instrument is not traveling level. At 360 degrees the instrument should again point exactly at the target points. If it does not, the instrument or fixture may have shifted. The test must be repeated.

b. The error may be in the levels of the mount (par. 28) or the shaft of the azimuth wheel may be bent, and in this case the part should be returned to a base shop or arsenal for repair.

33. TEST AND ADJUSTMENT OF VARIABLE POWER MECHANISM (ELBOW TELESCOPE M35 ONLY).

a. This test is to be made with the reticle, erector lenses, and the eyepiece assemblies assembled to the erecting lens tube and cam tube, and the whole removed from the outer tube of the telescope. Set the unit up on V-blocks and illuminate the reticle moderately. Set up a collimating telescope (fig. 57) between the repairman's eye and the eyepiece of the telescope.

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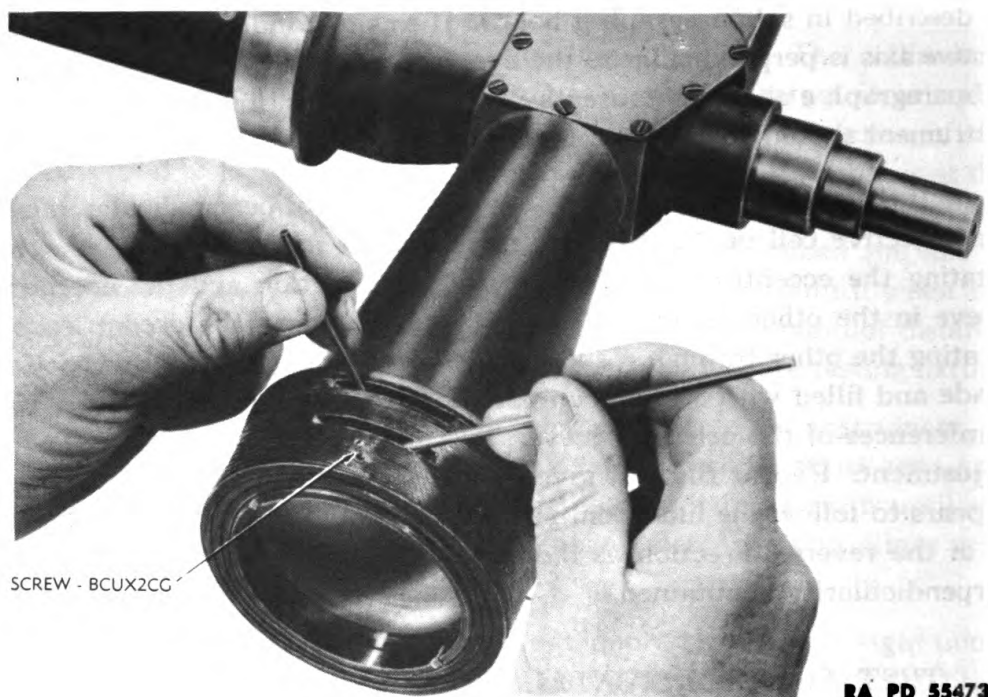


Figure 58—Telescope M3—Adjusting Eccentric

b. Set and clamp the rear erector assembly B174952 as close as possible to the original position. This position should have been marked during disassembly. Turn the variable power sleeve to indicate 10 power.

c. Turn the eyepiece to give the sharpest focus on the reticle pattern within the range of rotation of the eyepiece. Turn the variable power sleeve through its range to 20 power, observing the reticle focus throughout the travel.

d. If the reticle focus is sharp throughout the range from 10 to 20 power of the variable power sleeve, then the spacing between the front and rear erector assemblies is correct.

e. If the reticle focus is not sharp throughout the range from 10 to 20 power of the variable power sleeve, then the spacing between the front and rear erector assemblies is not correct. Adjust the front erector assembly B174951 until the focus remains sharp throughout the 10 to 20 power range. To adjust the front erector assembly, set the sleeve to about 10 power to align the access hole of the tube B16809 (fig. 12) with the slotted tube C79592. Note the position of the slots in the cell of the erector assembly B174951; then turn the cell in one direction or the

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other until a point of optimum sharpness has been obtained, checking as described in subparagraphs c and d above.

f. Read the diopter scale. If the scale reads zero, the scale is correctly set. If the diopter scale is slightly off, the scale may be shifted by drilling and tapping a new hole in the cell of the eyepiece assembly. This may be done only if at the new setting the eyepiece may be turned through the range of the diopter scale.

g. Where the error cannot be compensated for as described in subparagraph f above, it will be necessary to move both erector assemblies a uniform amount. Access to the rear erector assembly B174952 is obtained by turning the sleeve towards 20 power, releasing the clamping screw BC0X1CE through the access hole, then turning towards 10 power to reach the adjusting slots of the rear erector assembly.

h. Check the adjustment by going through the steps outlined in subparagraphs c, d, and f above.

34. TEST AND ADJUSTMENT FOR PARALLAX.

a. Examine each telescope for parallax. This test and adjustment may be made with the instrument mounted on its own tripod or on a testing fixture.

b. Elbow Telescope M35 Or Telescope M3.

(1) In examining the Elbow Telescope M35 or the Telescope M3, point the telescope at the sky, set the magnification at maximum power, and turn the knurled focusing ring and the adapter scale until the reticle pattern appears sharpest.

(2) Without changing the setting of the eyepiece, turn the telescope or elbow telescope to point at a fairly distant aiming point. Move the eye from side to side behind the eyepiece. Relative motion between the reticle and the image indicates that the telescope has parallax.

(3) To correct for parallax, loosen the screw BCUX2CG (fig. 21 or 34) sufficiently to clear the objective cell. The screw should still lock the eccentric rings. Carefully clear away the sealing compound in the exposed threads of the adapter A37201 (fig. 23 or 34) and, with a spanner wrench engaging the slots of the cell, screw the cell in or out slightly, and note whether the parallax has diminished or increased. Adjust until the parallax has disappeared and the objective lens is then focused on the reticle. Tighten the screw BCUX2CG to clamp the cell. Seal the threads of the adapter again with sealing compound. Care should be taken to avoid shifting the eccentrics as this will bring the objective optical axis out of perpendicular with the eyepiece axis.

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(4) After parallax has been removed, check, and adjust if necessary, the setting of the diopter scale (par. 33 f).

c. Elbow Telescope M2.

(1) Point the telescope at the sky and note whether reticle pattern appears sharp. If adjustment is required, loosen the screw BCUX1CB and screw the eyepiece assembly in or out until sharpest focus is obtained. Tighten the screw.

(2) Point the telescope at a fairly distant aiming point and move the eye from side to side behind the eyepiece. Relative motion between the reticle and the image indicates that the telescope has parallax.

(3) To correct for parallax, loosen the screw BCLX3CC, screw the objective cell in or out as required, and then drill and tap a new hole in the cell for the screw. This should be necessary only on a replacement of a lens or other part.

Section VII

DISASSEMBLY AND ASSEMBLY

	Paragraph
Precautions	35
Disassembly of mount	36
Disassembly of elbow telescope M35	37
Disassembly of telescope M3	38
Disassembly of elbow telescope M2	39
Assembly	40
Sealing after assembly	41
Inspection	42

35. PRECAUTIONS.

a. The following operations may be performed only by qualified ordnance personnel. The using arms are prohibited from attempting them.

b. To preserve the parts of the instrument, it is necessary to exercise care and close attention during disassembly, cleaning, and adjustment. The extent of disassembly for any certain repair job is determined by the repairman when he makes his detailed inspection.

c. All optical elements and metal components should be carefully marked or tagged as they are disassembled, to insure correct positioning in the instrument on reassembly. If parts are not so marked or tagged, considerable difficulty may be encountered in the final adjustment. Reference marks should be scribed when deemed advisable. An indelible pencil or diamond may be used for marking on *unpolished* surfaces of optical elements. Metal components may be scribed, marked, or tagged. Clean each lens, leaving mark on unpolished surface, and wrap in clean lens tissue until ready for reassembly.

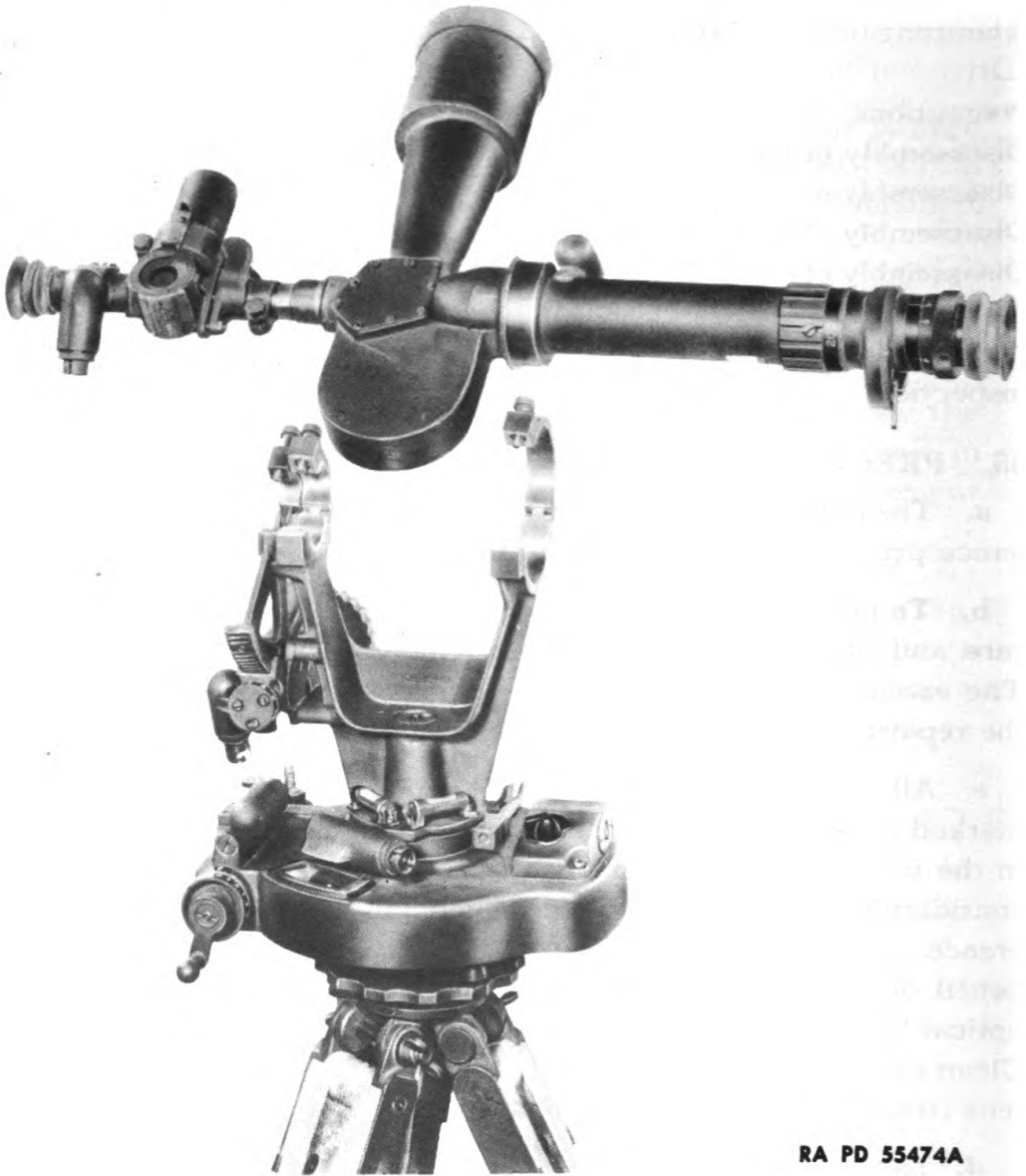
d. Defective parts should be replaced from stock. Replacement of defective optical elements must be carefully checked, inasmuch as replacement of even one optical element may change the optical characteristics of the telescope and render readjustment necessary. Replacement of metal components is easily accomplished, since the components are all standardized and available as replacements. Keep in mind, however, that the replacement of certain components, such as the reticle cell, may cause parallax and affect the final adjustment of the telescope.

36. DISASSEMBLY OF MOUNT.

a. Elevation Worm Housing.

(1) To remove the elevation worm housing C44209 first remove the stops A35724. Turn the elevation knob A36944 until the 1500-mil end

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**Figure 59—Removal Of Telescope M3 And Elbow Telescope M2
From Mount**

of the worm wheel segment C44568 clears the worm B16312 (fig. 61). Slide the segment clear of the guides in the worm housing, holding the worm wheel segment cap A38274 (fig. 62) opened for clearance. Remove the elevation scale lamp bracket B16315 (fig. 64) held by 2 screws BCGX3EF. Then unscrew the 4 fillister head screws BCGX3FF holding the housing to the yoke D9860. The 2 dowel pins BFDX4AM may be removed.

(2) The worm housing C44209 (fig. 65) may be disassembled either

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on or off the mount. Remove the 3 flat head screws BCLX3EE and the clamping disk A35720 and micrometer A32104 which the screws retain. Drive out the taper pin BFCX1M and pull the adapter A35719 off the worm shaft B16312. Remove knob assembly B138940 and its taper pin BFCX1M. The stud A36945 is riveted to the knob and should not be disassembled except to replace broken parts. The compression spring A34447 can be removed from the housing after the plug A43656 and lock screw BCUX1EC have been withdrawn. To remove the worm B16312, first loosen the locking screws BCUX1EC and unscrew the ball cap A32118. The worm and ball socket A32123 may then be withdrawn. The worm plunger A37208 is then free.

(3) Carefully remove the elevation scale B16314 (fig. 63) which is held by 3 screws BCLX3DD and 2 dowel pins BFDX1BC.

b. Yoke And Housing.

(1) Remove the fillister head screw BCCX1BA (fig. 67) and washer A38258. Throw the azimuth worm out of mesh with the azimuth gear and lift both yoke D9860 and housing D29361 off the spindle of the azimuth gear. Remove washer A38266.

(2) Before separating yoke and housing, unscrew plug A38283 (fig. 74) and remove spring A38253 and plunger A38252. The plug should be removed carefully, since the spring is under pressure.

(3) To separate the yoke and housing, remove the 4 fillister head screws BCCX1AR (fig. 71) and retaining washer A43424.

(4) In reassembly, put the yoke washer A38266 on the yoke and gently lower the yoke over the gear spindle to engage the pins. In reassembly, the felt strip A38275 (fig. 68), cemented in its groove, should be carefully tucked in all around to give uniform protection.

c. Azimuth Slow-Motion Arm.

(1) When the yoke and housing have been separated, the azimuth slow-motion arm B129177 (fig. 74) can be removed from the hub of the yoke by loosening the clamping screw A38251.

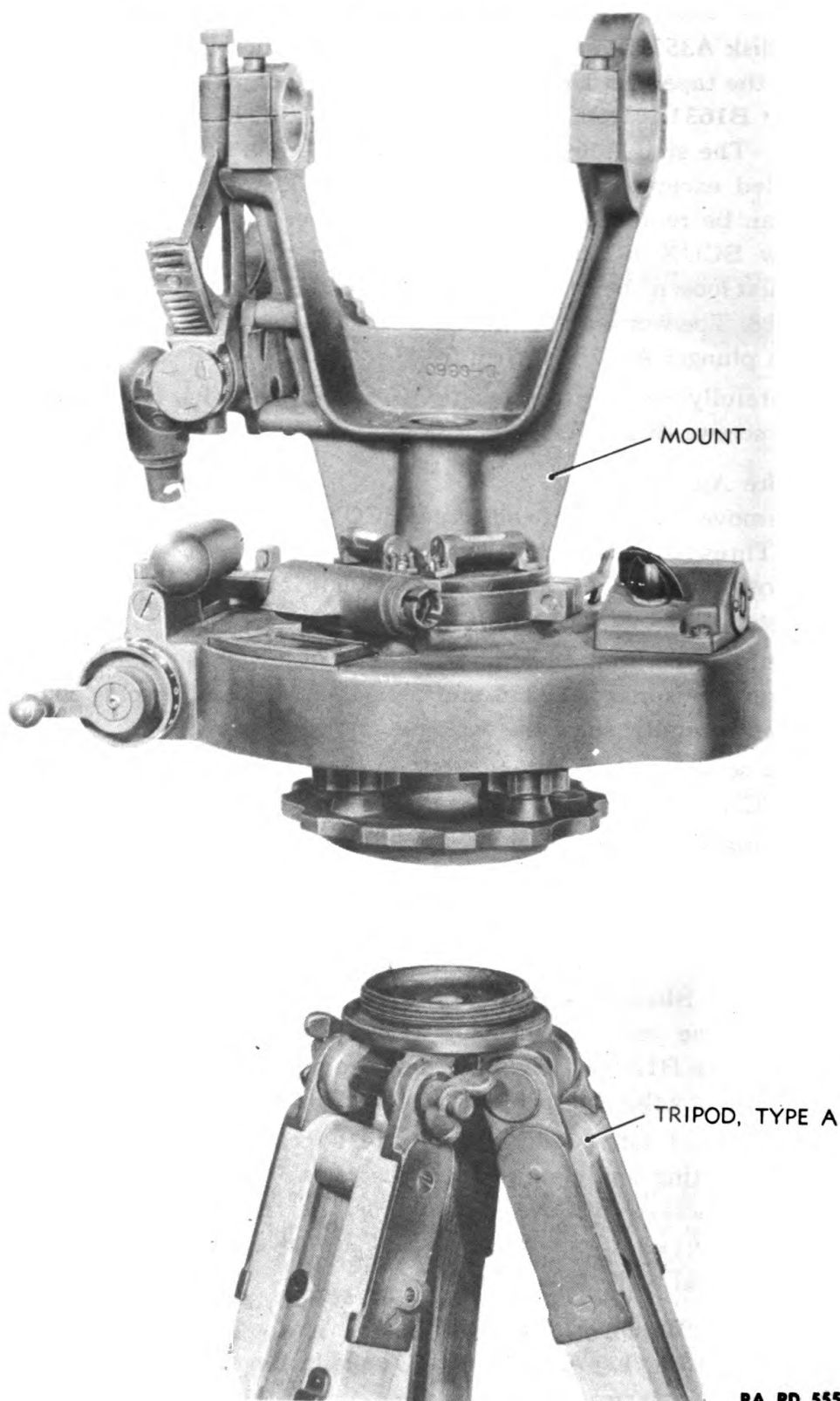
(2) Mounts of late manufacture have a bracket A45429B which holds the adjusting and clamping thumbscrews. This is secured to the housing by 2 screws BCGX3FD and may be removed at this time. Mounts of early (serial numbers 1 to 534 inclusive) manufacture have a lug cast integral with the housing.

d. Azimuth Worm Mechanism.

(1) Remove the plug A38279 (fig. 77), its locking screw BCUX1EC, and the compression spring A38281.

(2) To remove the azimuth crank A38245 and its key A38255,

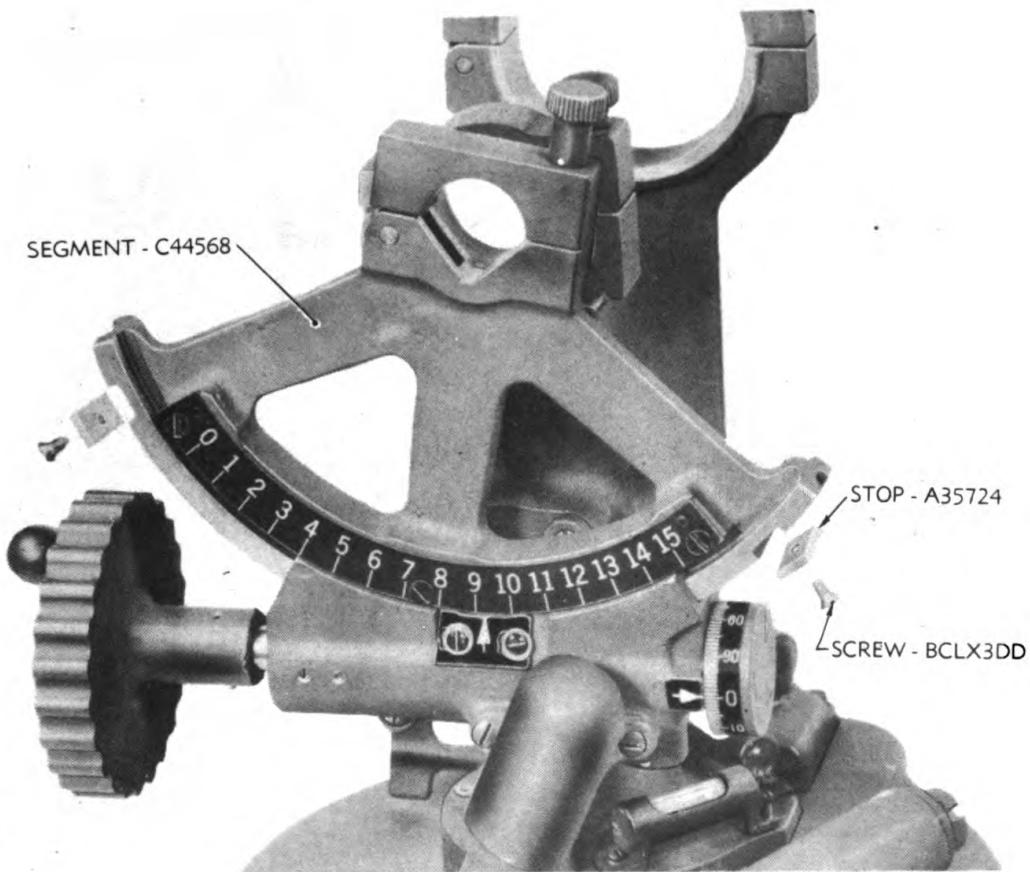
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Figure 60—Removal Of Mount From Tripod

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Figure 61—Removal Of Stops On Elevation Worm Wheel Segment

loosen the locking screw BCUX1EE and nut A38248. The micrometer may then be pulled off the shaft.

(3) Loosen locking screws A179601 and BCUX1EE and unscrew the ball cap A34054. The worm B129181 and ball socket A32124 may then be removed.

e. Throwout Lever. Drive out pin BFCX1M (fig. 77) and lift the lever A38277 off the cam A38276. Loosen the lock screw BCUX1EC and unscrew the retaining ring A38278. Pull out the cam.

f. Azimuth Lamp Bracket, Index, And Azimuth Window.

(1) Remove the lamp bracket B129182 (figs. 75 and 76) held by 2 screws BCGX3DF. Unscrew the socket assembly B16301 from the bracket B129182 and remove the lamp A35189 if necessary.

(2) For instruments, serial numbers 1 to 534 inclusive, remove the azimuth index A38262 and the azimuth window A38263 held by 2 fillister head screws BCGX3FF.

(3) For instruments, serial numbers 535 and up, remove the frame

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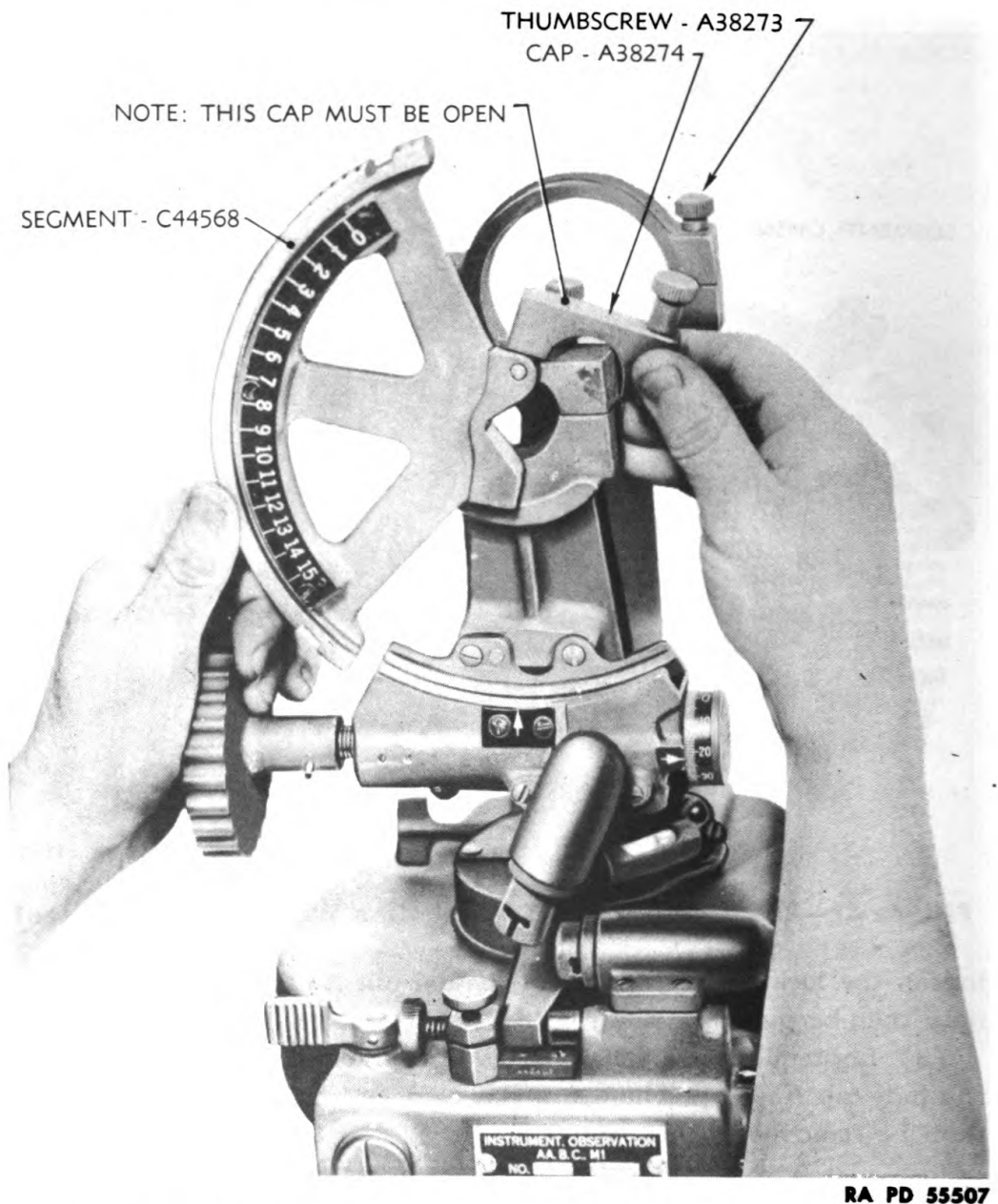
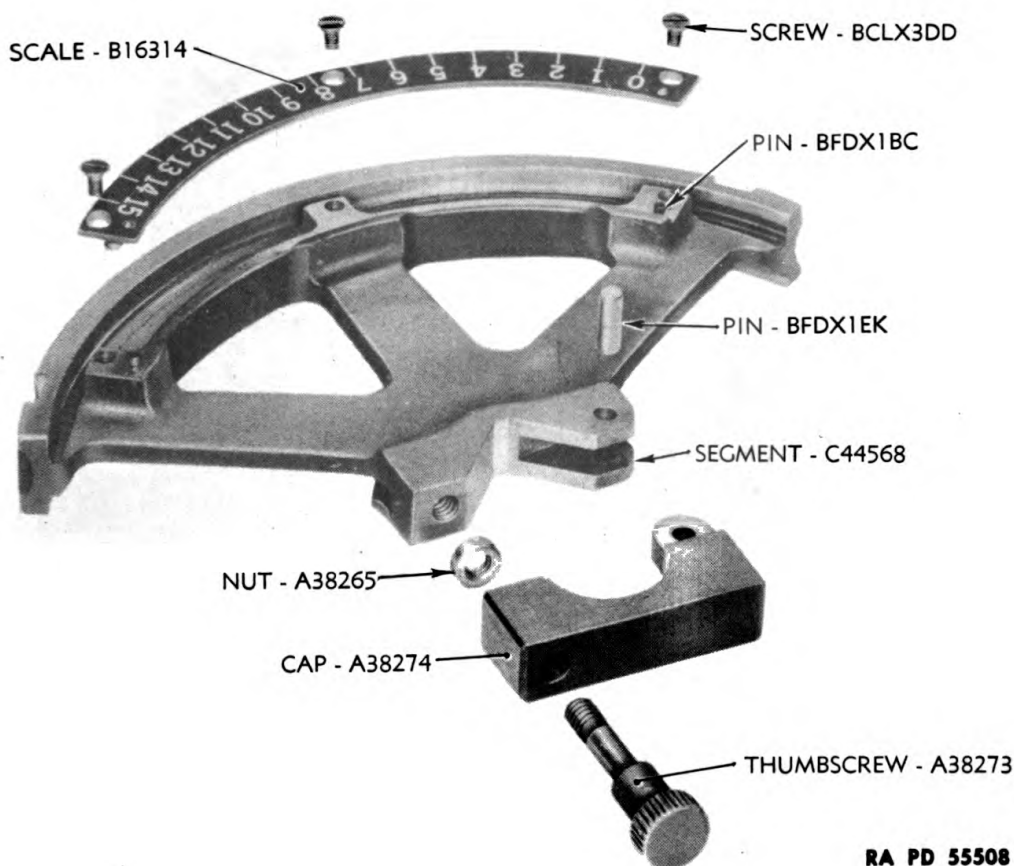


Figure 62—Removal Of Elevation Worm Wheel Segment

B137899 (fig. 78) secured by 4 screws BCLX3DF and push out the window A48842 held in place by sealing compound. Remove or adjust the azimuth index A38262 held by 2 screws BCGX3FF. In reassembly seal the window.

g. **Leveling Plate** (figs. 69 and 70). Remove flat head screw BCLX3DD and unscrew the leveling ball A38249. The leveling plate B129179 and worm wheel will then be disassembled and the 4 leveling

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Figure 63—Removal Of Elevation Scale And Cap

screws A36371 together with leveling screw shoes A38250 can be removed. This screw and shoe should not be separated except for replacement of parts, since the shoe is spun on the screw.

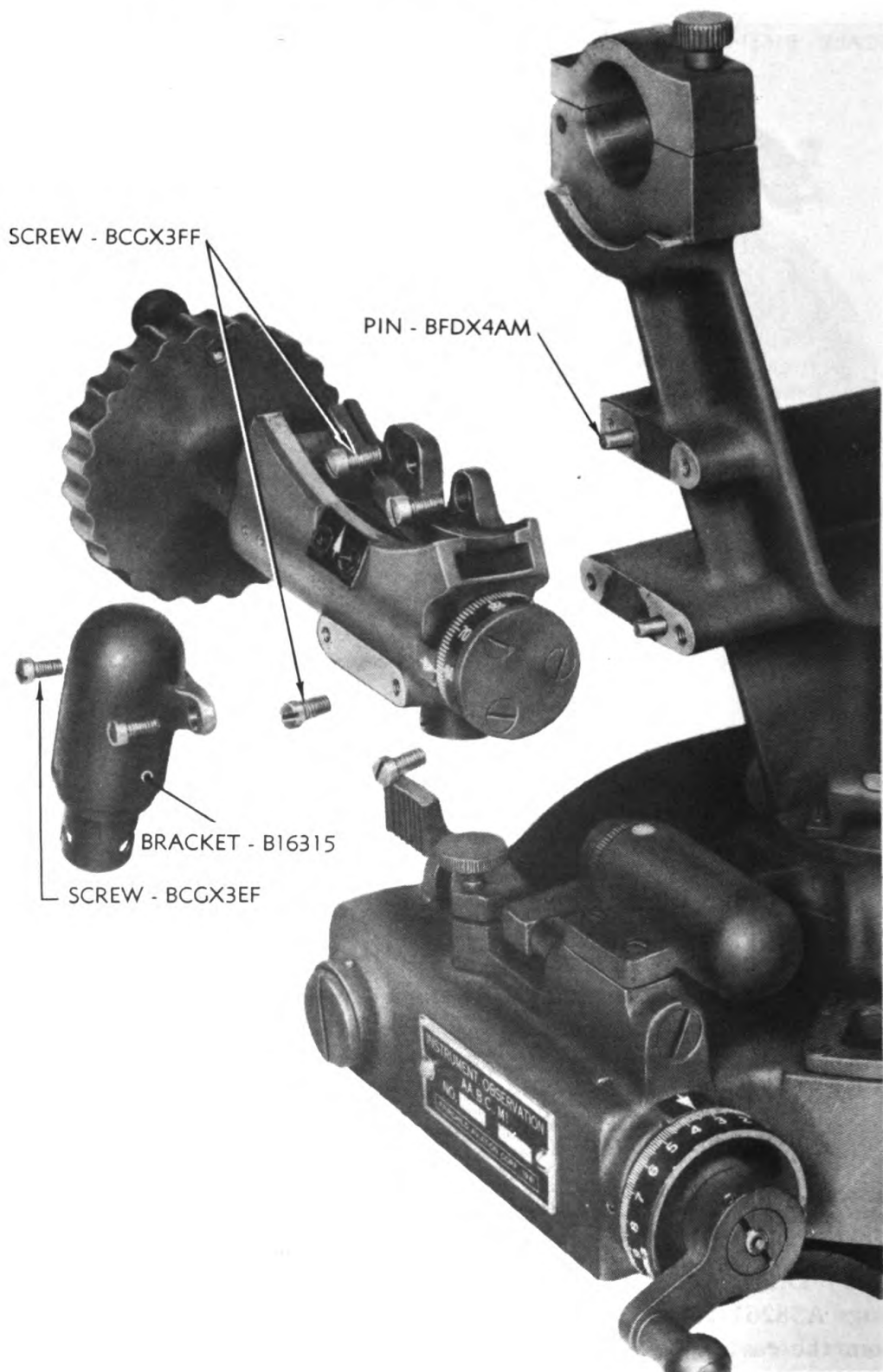
h. Yoke Caps. The yoke caps are machined assembled to the yoke and should not be disassembled except for replacement. The clamping screws A38282 (fig. 72) are held in place by nuts A38265 which must be loosened if replacement of the screws is required.

i. Level Vials.

(1) Remove the level vial holder from the yoke by loosening the clamping fillister head screw BCGX3CE (fig. 72) and then removing the holding fillister head screws BCGX3DD.

(2) Disassemble the level vial holder if necessary by unscrewing the plugs A38261 (fig. 73) and removing all broken glass and old packing from the cavity. Place new vial in position, center graduations in the opening, and pack level vial lightly in position with paper strips. Secure with calcined gypsum (plaster of paris) which has been mixed to medium

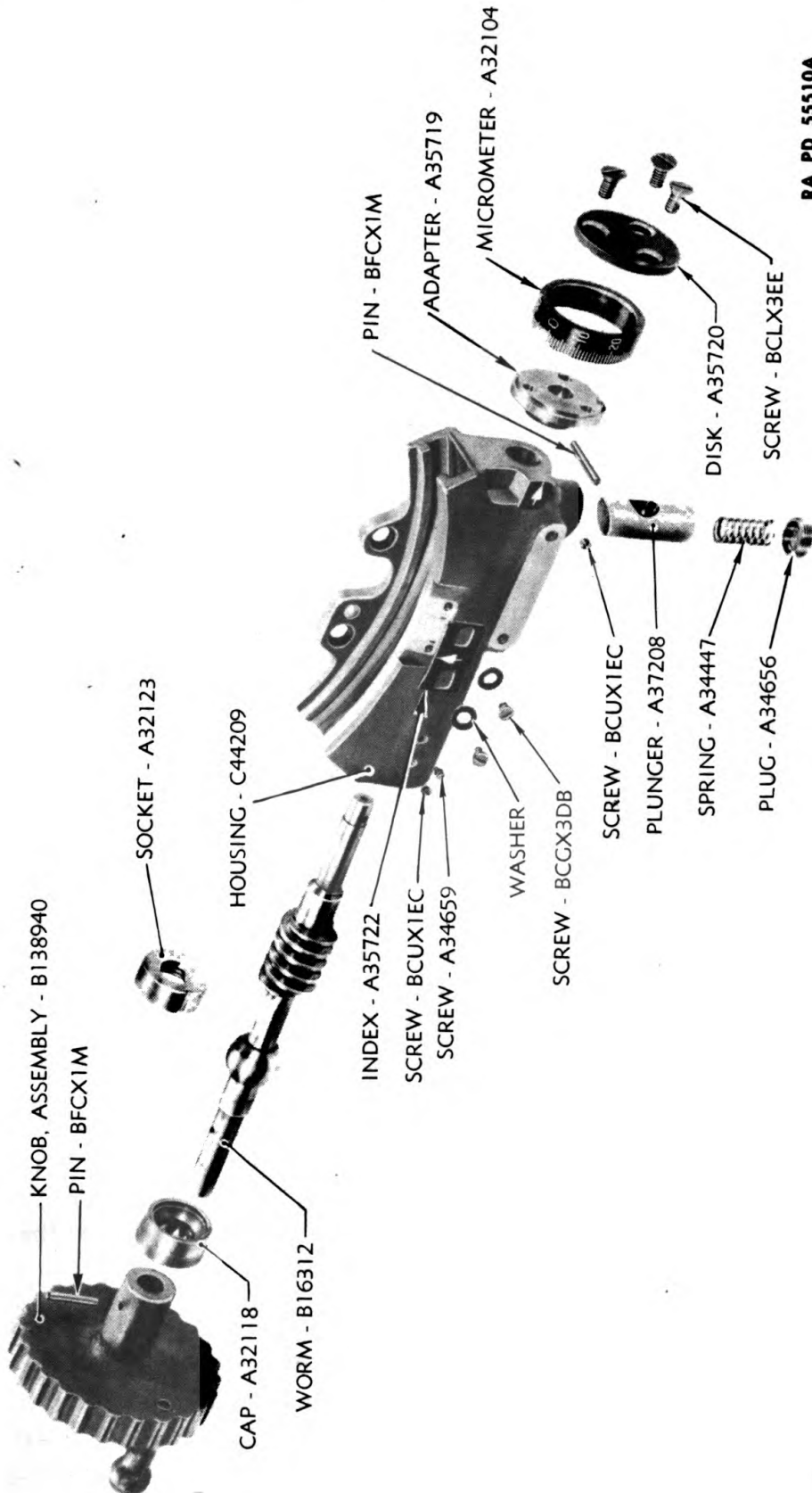
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RA PD 55509

Figure 64—Removal Of Elevation Worm Housing And Lamp Bracket

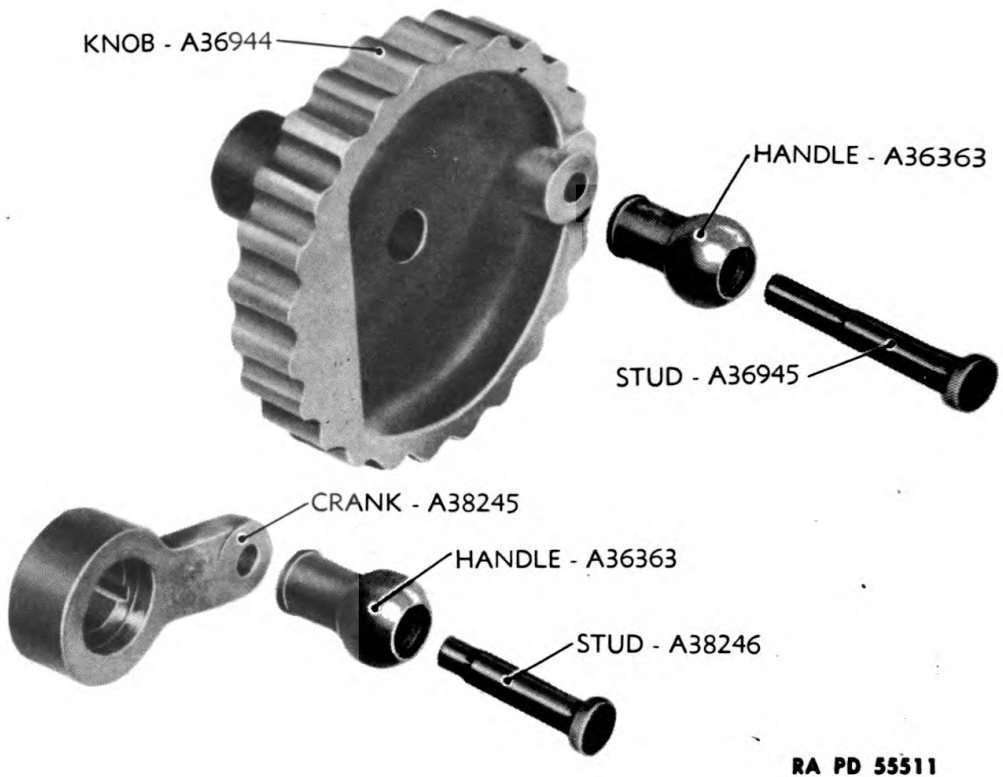
DISASSEMBLY AND ASSEMBLY



RA PD 55510A

Figure 65—Elevation Worm Mechanism And Index Disassembled

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RA PD 55511

Figure 66—Elevation And Azimuth Knobs Disassembled

consistency. Replace plugs. Remove excess plaster from surfaces after plaster has set. For adjustment to mount see paragraph 28.

j. Rheostat.

(1) For instruments, serial numbers 1 to 534, remove rheostat assembly 14-4-99 clamped by rheostat bracket A39119 and 2 screws BCOX3EE.

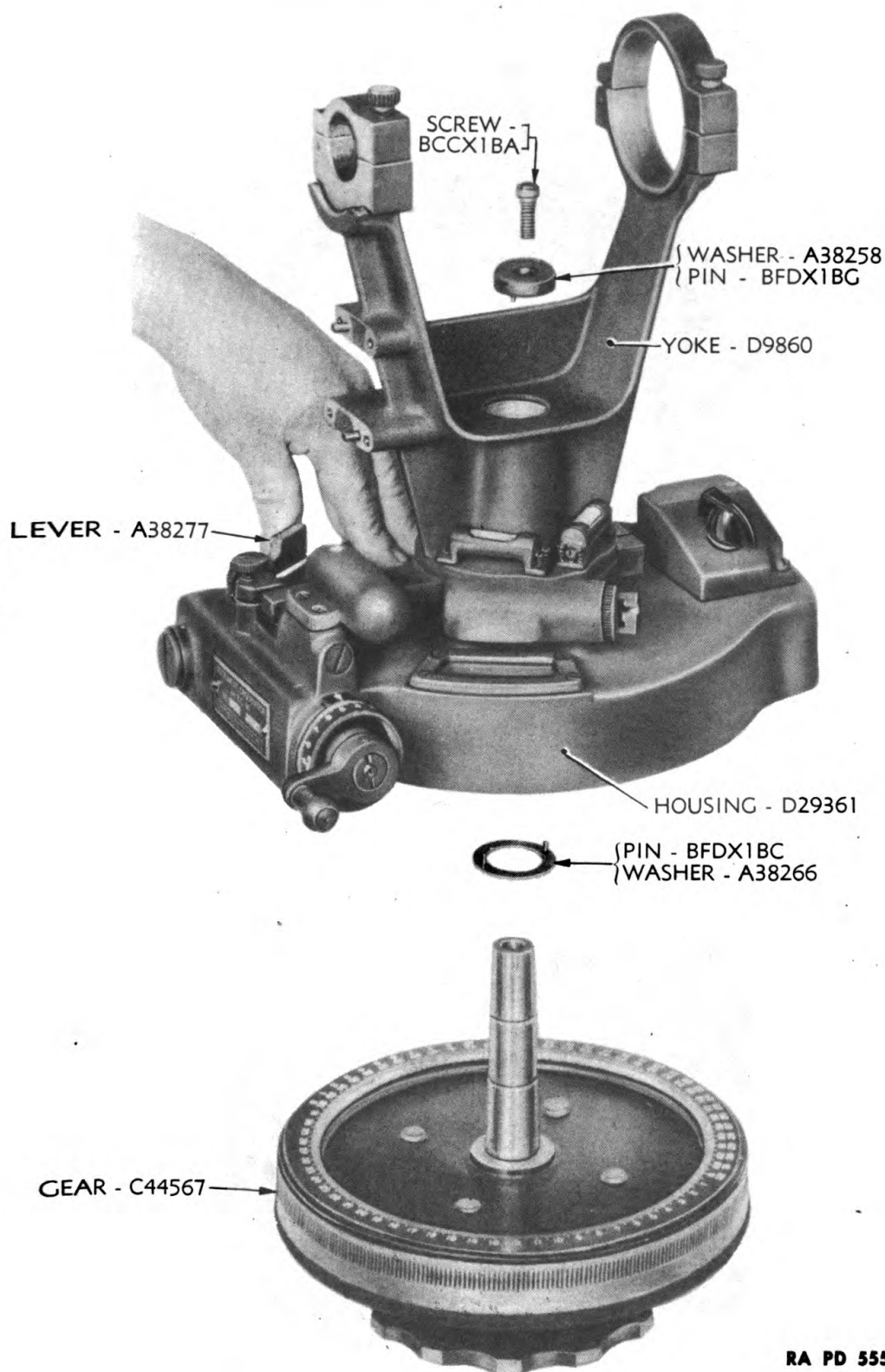
(2) For instruments, serial numbers 535 and up, remove the rheostat box assembly C70155 (fig. 75) held by 2 screws BCGX3FG and washers. Disassemble the rheostat box assembly C70155 by unsoldering the leads at the rheostat and sliding off the knob, held by a set screw. Remove the nut and washer locking the rheostat in the box B137652 (fig. 79). Remove the socket A34791 and the lead wires. Unsolder the leads and then unscrew the 2 terminals A43910.

37. DISASSEMBLY OF ELBOW TELESCOPE M35 (figs. 10 to 26).

a. Removal And Disassembly Of Telescope Adapter.

(1) Remove the Elbow Telescope M2 from the telescope adapter assembly C44326 (fig. 80) by loosening the bolt BCBX1BA of the adapter with the wrench TKKX1G which is available in the packing

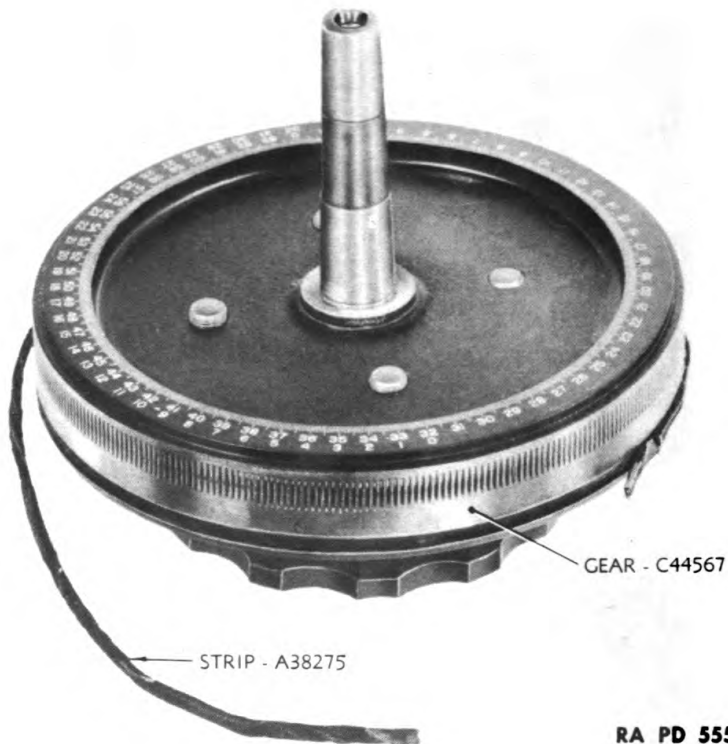
DISASSEMBLY AND ASSEMBLY



RA PD 55512

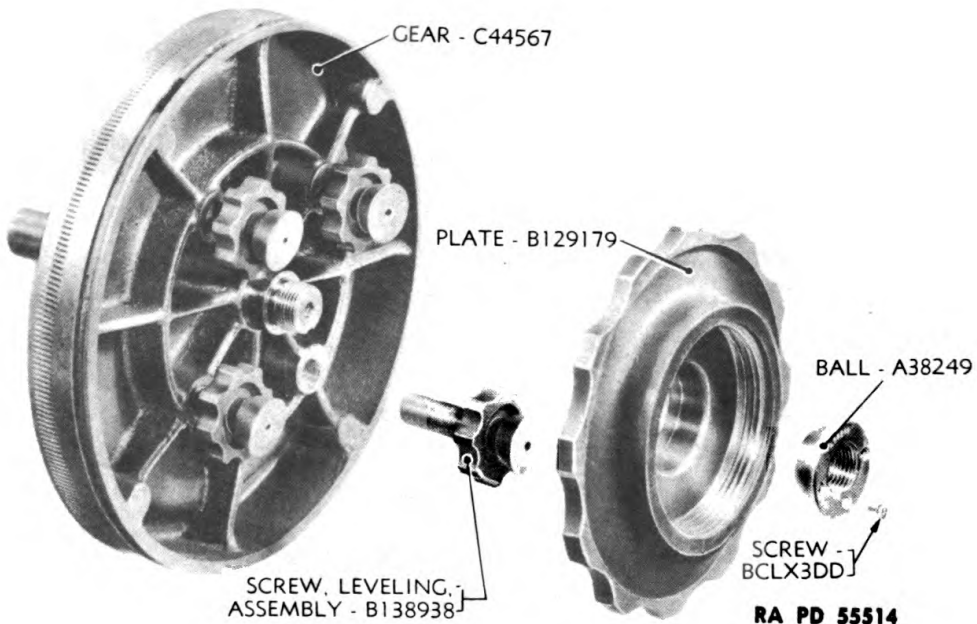
Figure 67—Removal Of Yoke And Housing From Spindle

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RA PD 55513

Figure 68—Removal Of Felt Strip



RA PD 55514

**Figure 69—Removal Of Leveling Plate, Showing Leveling Ball And
One Leveling Screw Removed**

DISASSEMBLY AND ASSEMBLY

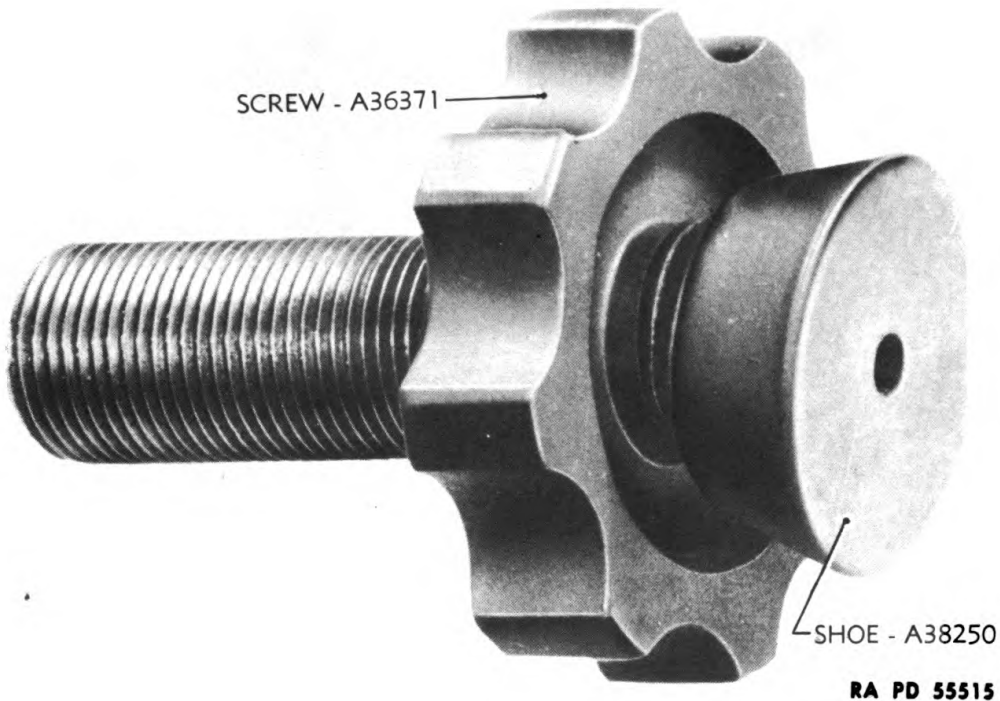


Figure 70—Leveling Screw

chest for the mount. Remove the adapter assembly from the stud of the Elbow Telescope M35 by loosening the bolt BCBX1BA in the bracket B16796 (fig. 82) and pulling the adapter assembly with its spring A35006 off the stud.

(2) Disassemble the adapter, if necessary, by removing the 2 bolts BCBX1BA already loosened, and unscrewing the screw A37315A and nut BBDX1A. Remove the pin BFCX1M which holds pin A35007, and separate holder B16797 which is held to bracket B16796 by the latter pin. Remove the open sight A36789 held to holder B16797 by 2 screws BCOX3CC.

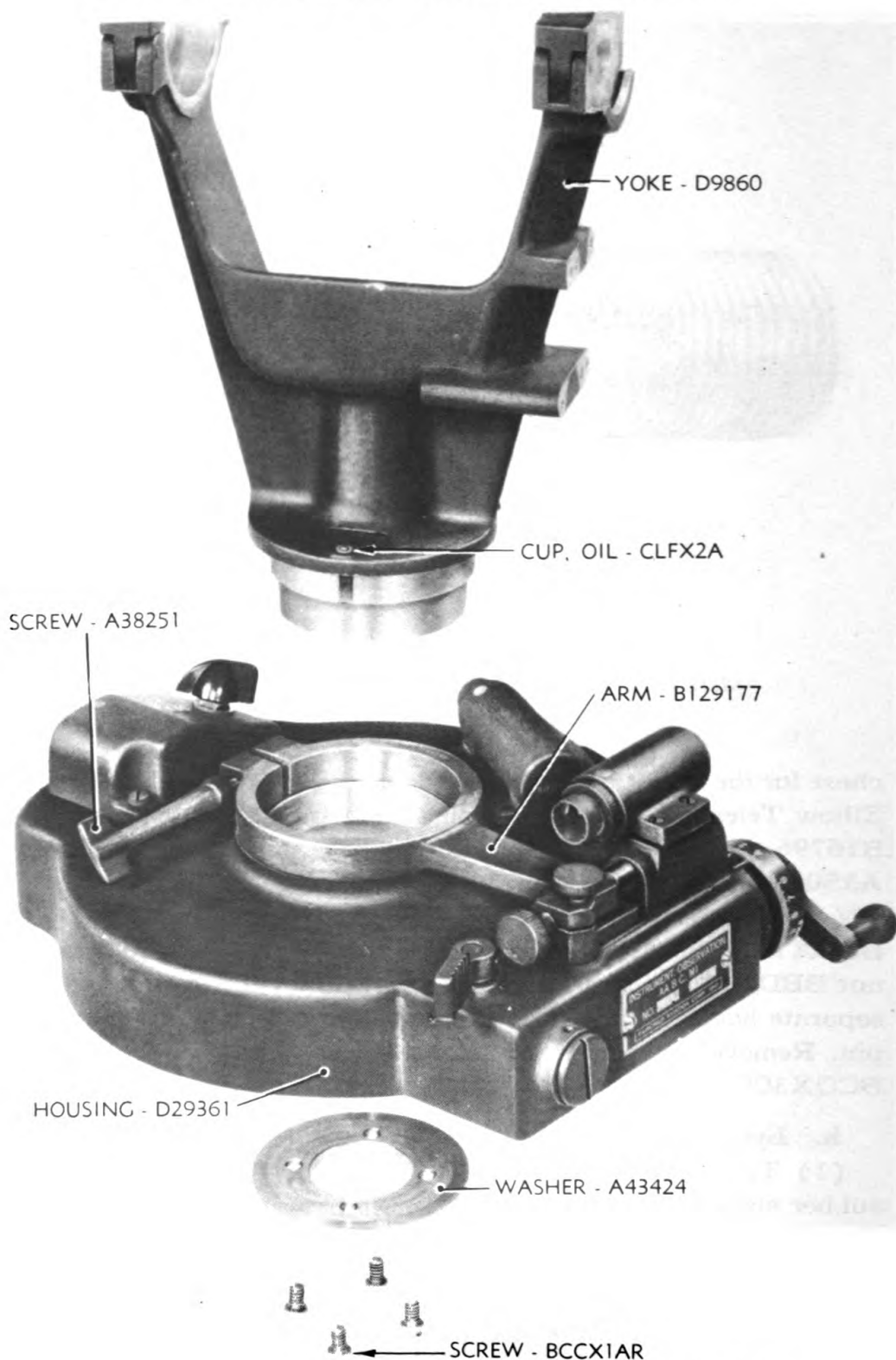
b. Eyepiece.

(1) To remove the eyepiece assembly C79590 (fig. 12) first pull the rubber eye shield A37235 radially outward at one point, stretch it over the retaining shoulder, and work around the circumference in this way. Withdraw the 3 screws BCLX3CD and slide the diopter scale A37228 off the eyepiece assembly.

(2) Remove the 2 screws BCLX3CC which retain the 2 halves of the stop A37227. Unscrew the eyepiece assembly, catch the stops as they slide out, and remove the eyepiece assembly.

(3) To disassemble the eyepiece assembly C79590 (fig. 19), mark

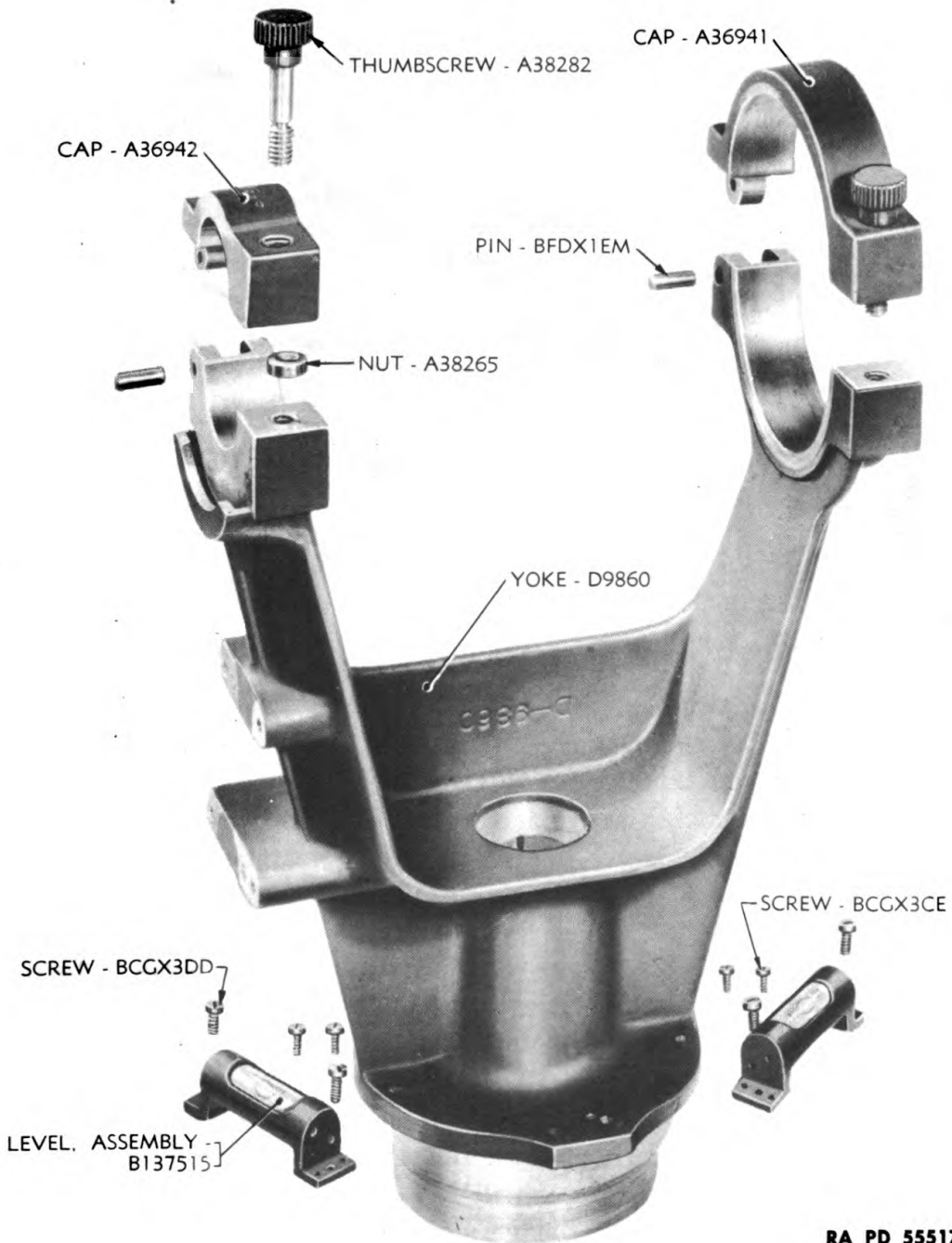
**ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
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RA PD 55516

Figure 71—Yoke And Housing Disassembled

DISASSEMBLY AND ASSEMBLY

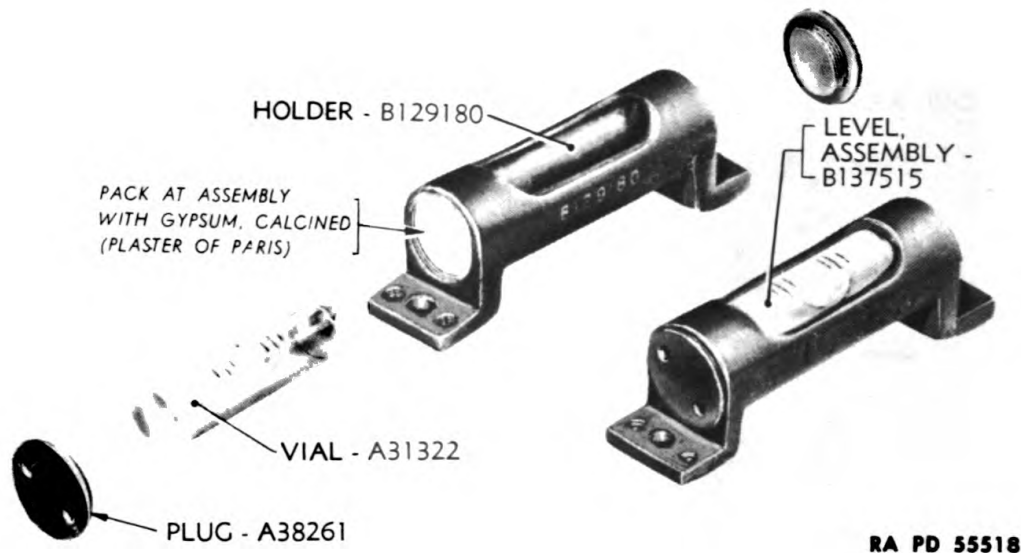


RA PD 55517

Figure 72—Removal Of Yoke Caps And Levels

the position of cell A184313 with respect to cell B173715. Unscrew cell A184313 carefully to avoid damage to eyelens A184995 which turns with the cell and is held in it by sealing compound. Carefully slide the separator A184314, lens A184996, separator A184312, and lens A184994 out of the cell B173715, noting the positions for reassembly.

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RA PD 55518

Figure 73—Level Assembled And Disassembled

c. Eyepiece Adapter.

(1) To remove the eyepiece adapter assembly C79591 (fig. 16) unscrew the 4 fillister head screws BCGX3EG.

(2) To disassemble the eyepiece adapter C79591, drive out the taper pin BFCX1B and pull off lever A35666. Slide amber filter assembly B173962 (fig. 17) and blue filter assembly B173963 (fig. 18) out of adapter B16811.

(3) The detent A37236 is riveted to the adapter and is not to be disassembled except for replacement.

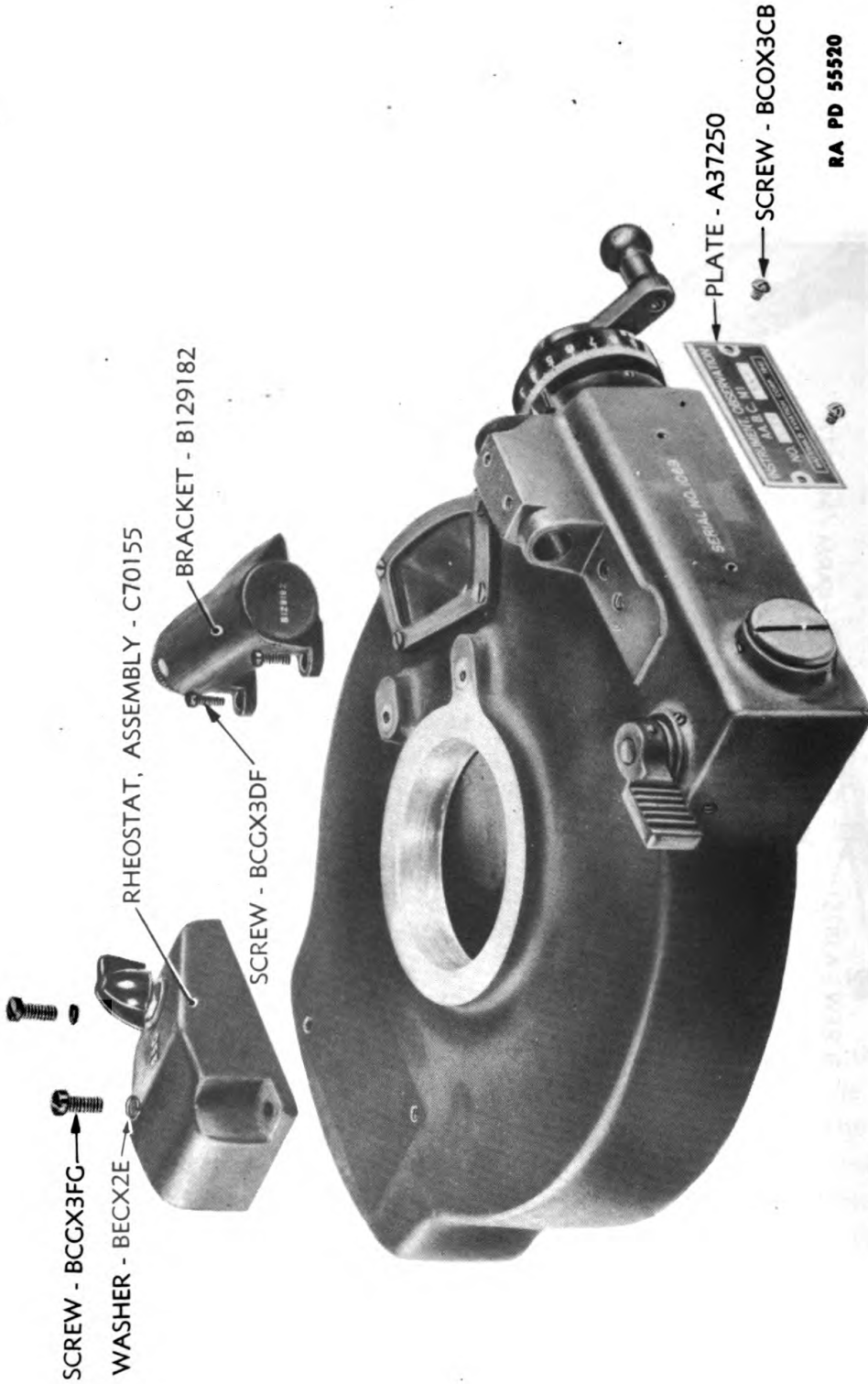
(4) The filters are spun into the filter assemblies and are not to be disassembled.

d. Removal Of Variable Power Mechanism. Remove the screw BCLX3DD (fig. 12) nearly opposite the reticle window and the 2 screws BCUX3CF which secure the reticle lamp bracket. Grasp the housing B16810 and carefully pull the variable power mechanism out of the body tube B16808 of the telescope. In reassembly, guide the mechanism in carefully to avoid damage to the focusing sleeve A37229 or the sleeve A37223.

e. Disassembly Of Variable Power Mechanism.

(1) **REMOVAL AND DISASSEMBLY OF RETICLE ASSEMBLY.** To remove the reticle assembly M175457 (fig. 13) remove the flat head screw BCLX3DD and unscrew the reticle assembly from the erecting lens tube B16809. To disassemble the reticle assembly, loosen the locking screw BCUX1CE and remove the ring A37213. Remove the reticle A37204.

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RA PD 55520

**Figure 75—Removal Of Rheostat, Azimuth Scale Lamp Bracket
And Name Plate**

DISASSEMBLY AND ASSEMBLY

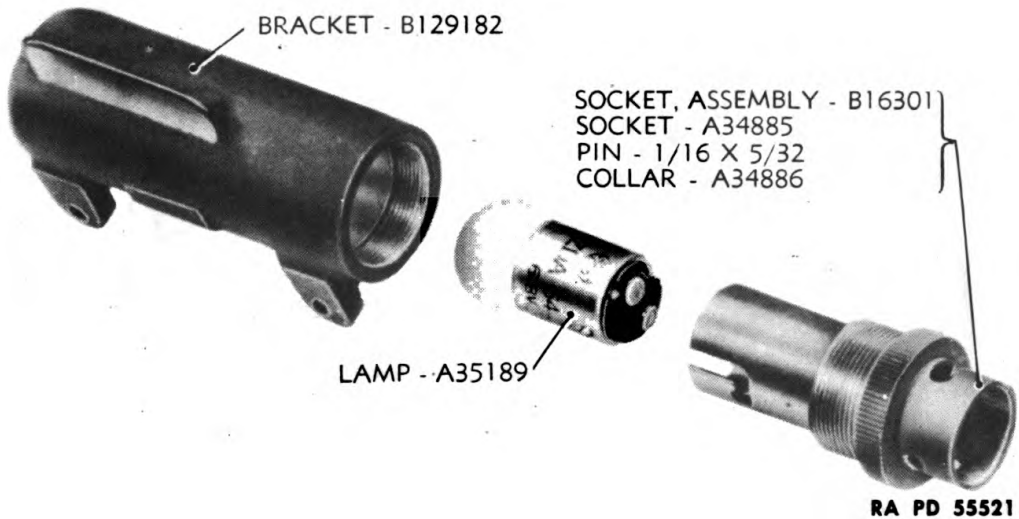


Figure 76—Azimuth Scale Lamp Bracket Disassembled

(2) **REMOVAL OF ERECTOR ASSEMBLIES.** To remove the erector assemblies B174952 (fig. 15) and B174951 (fig. 14) set the magnification to approximately 10 power, alining the forward helix slot with the round access hole in the tube B16809. Loosen slightly the screw A35651 holding shoe A35649. Insert a thin wooden rod through the access hole, press it against the adapter B173239 to relieve the spring tension on the shoe, and remove the screw and shoe. Aline the shoe assembly B173716 (fig. 20) with the straight slot in the helix tube and remove the shoe assembly, held by 2 screws BCUX1CE. Slide both adapters out of the tube. Remove the springs A183779 and screws BCGX3CR.

(3) **DISASSEMBLY OF ADAPTERS.** Before altering the setting of the erector assemblies carefully mark their positions in the adapters. To disassemble the adapter B17329, remove the screw BCUX1CE and screw the erector assembly B174951 out of the adapter. Remove the erector assembly B174952 in similar manner.

(4) **DISASSEMBLY OF ERECTOR ASSEMBLY B174952 (fig. 15).** Loosen the lock screw BCUX1CB and unscrew the ring A182843. The erector A184993 with the notched lens is assembled to this cell.

(5) **DISASSEMBLY OF ERECTOR ASSEMBLY B174951 (fig. 14).** Loosen the lock screw BCUX1CB, unscrew the ring A182843 and remove erector A184997.

(6) **REMOVAL OF ERECTING LENS TUBE.**

(a) Unscrew the 3 screws BCLX3EE and slide the focusing sleeve A37229 off the sleeve A37223.

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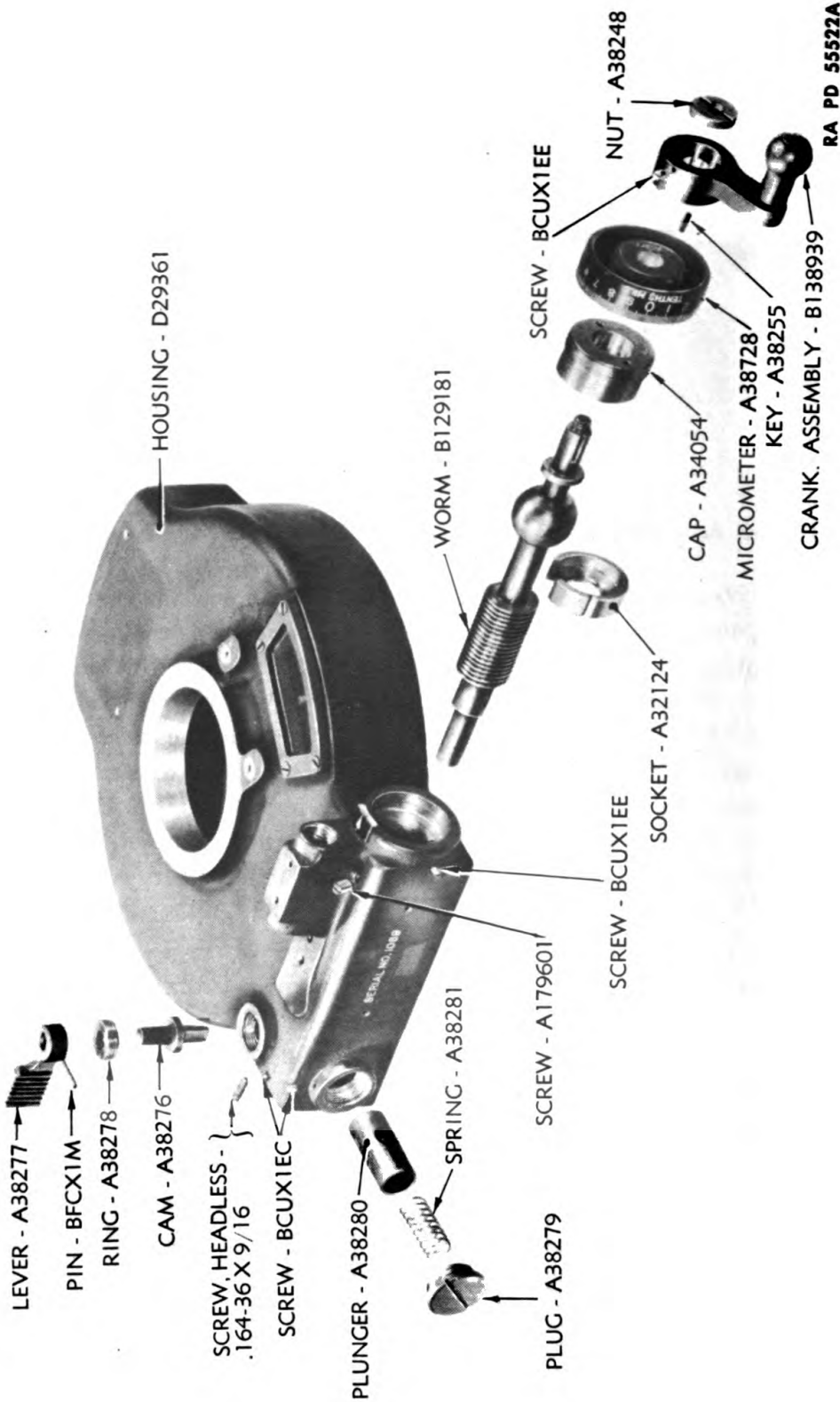
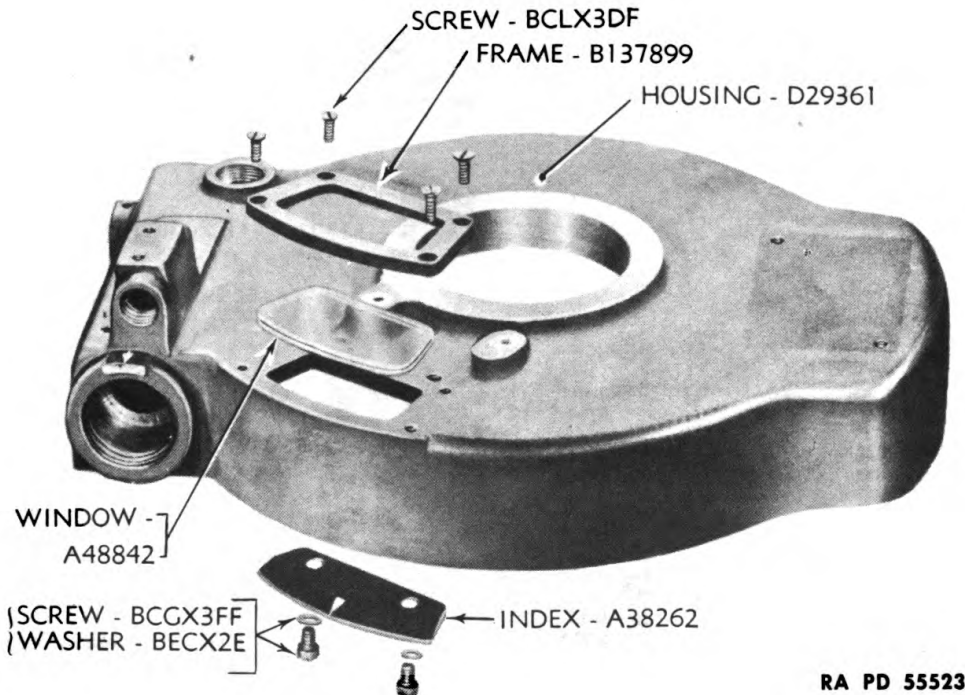


Figure 77 — Azimuth Worm Mechanism And Throwout Lever Disassembled

DISASSEMBLY AND ASSEMBLY



RA PD 55523

Figure 78—Azimuth Scale Window And Index Disassembled

(b) Slide the cam tube C79592 (fig. 12) off the erecting lens tube B16809. If replacement is required, drive out the 3 pins ($\frac{3}{32} \times \frac{5}{32}$) which hold the sleeve A37223 and the bushing A37222 to the cam tube.

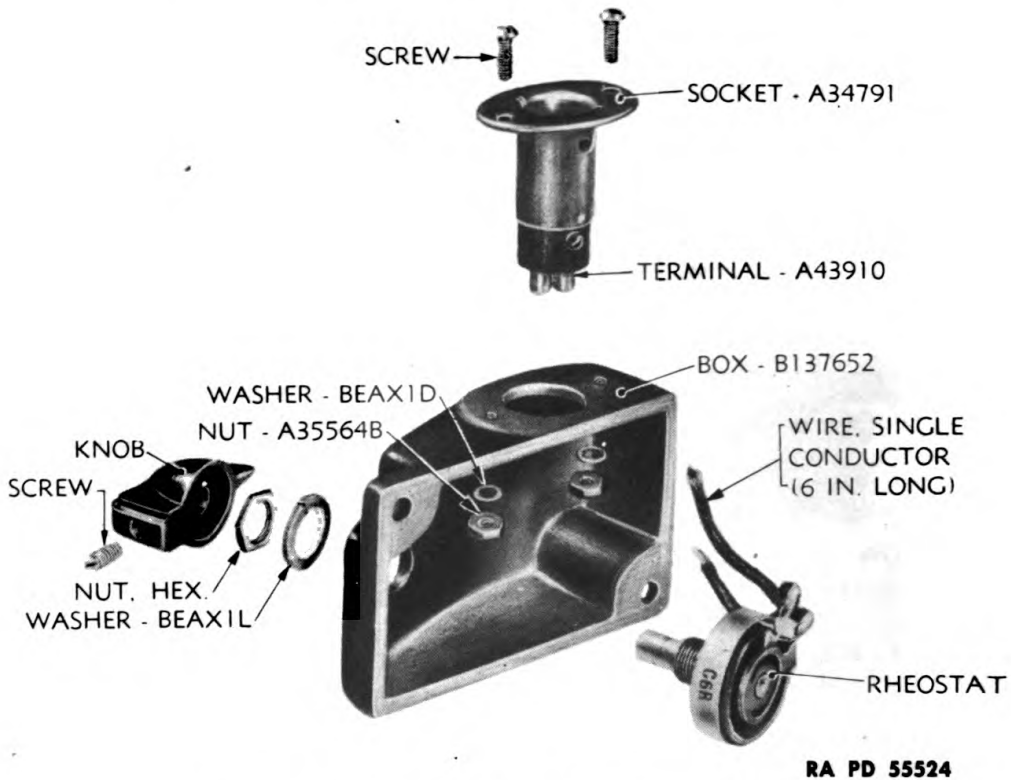
(c) Remove the 3 screws BCLX3DE and unscrew the erecting lens tube B16809 from the housing B16810.

f. **Removal Of Objective.** Unscrew the sunshade assembly B173436 (fig. 25). Remove the lock screw BCUX2CG. Unscrew the ring A37203. Mark the positions of the objective assembly B173435 (fig. 23) and the eccentric ring A37202 with respect to the telescope body D9917. Pull the objective assembly and the ring out of the body. The slots in the body may be used as access holes for turning and shifting the objective assembly.

g. **Disassembly Of Objective Assembly.** Unscrew the cell A37198 from the adapter A37201 (fig. 100). Remove the screw BCUX1BB, unscrew the retaining ring A37200, and push the objective A37199 out of the cell A37198. In reassembly, seal the objective in the cell with sealing compound.

h. **Removal Of Penta Prism.** Remove the 9 screws BCLX3DD and

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RA PD 55524

Figure 79—Rheostat Box Disassembled

cover A37207, and pad A37242 (fig. 102). Pull out the wedge A37210 and the prism spring A37209 (fig. 101). Lift out the penta prism A37206. In reassembly, coat the mating surfaces of cover and body with sealing compound.

38. DISASSEMBLY OF TELESCOPE M3 (figs. 80 to 102).

a. Removal And Disassembly Of Telescope Adapter.

(1) Remove the Elbow Telescope M2 from the telescope adapter assembly C44326 (fig. 80) by loosening the bolt BCBX1BA of the adapter with the wrench TKKX1G which is available in the packing chest for the mount. Remove the adapter assembly from the stud of the Elbow Telescope M3 by loosening the bolt BCBX1BA in the bracket B16796 (fig. 82) and pulling the adapter assembly with its spring A35006 off the stud.

(2) Disassemble the adapter, if necessary, by removing the 2 bolts BCBX1BA already loosened, and unscrewing the screw A37315A and nut BBDX1A. Remove the pin BFCX1M which holds pin A35007, and separate holder B16797 which is held to bracket B16796 by the latter pin. Remove the open sight A36789 held to holder B16797 by 2 screws BCOX3CC.

DISASSEMBLY AND ASSEMBLY

RA PD 55475

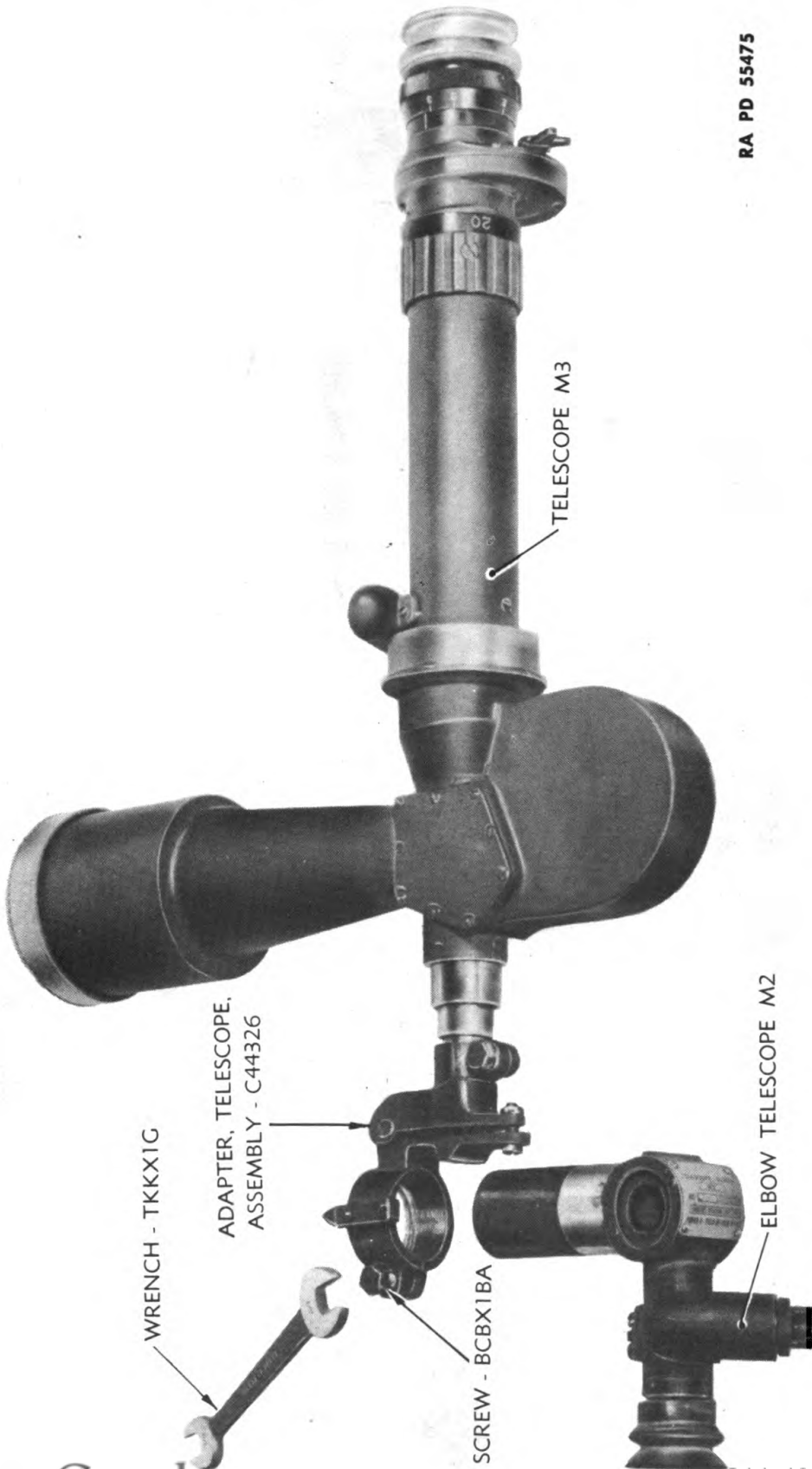


Figure 80—Elbow Telescope M2—Removal From Telescope Adapter Assembly

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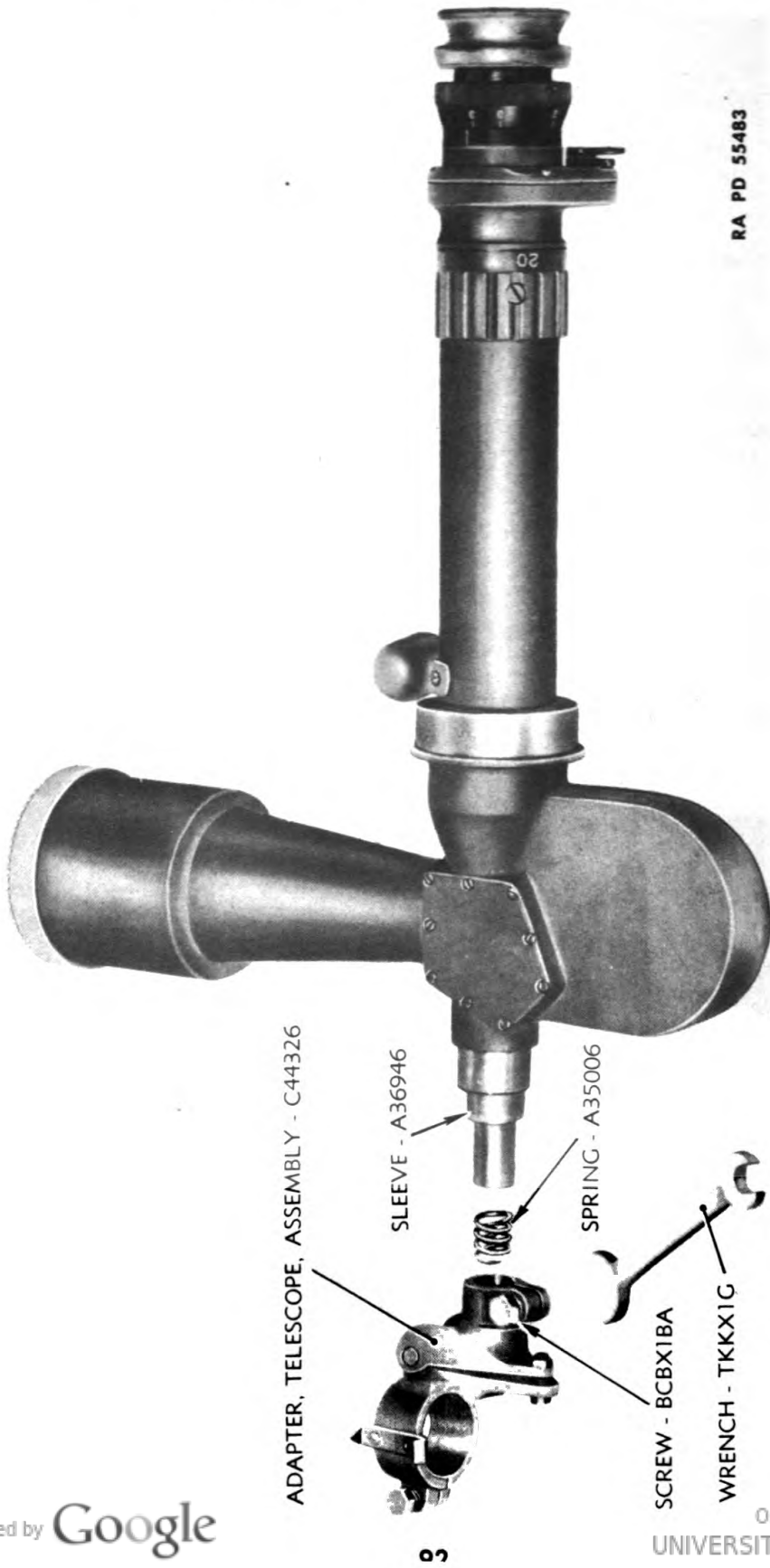
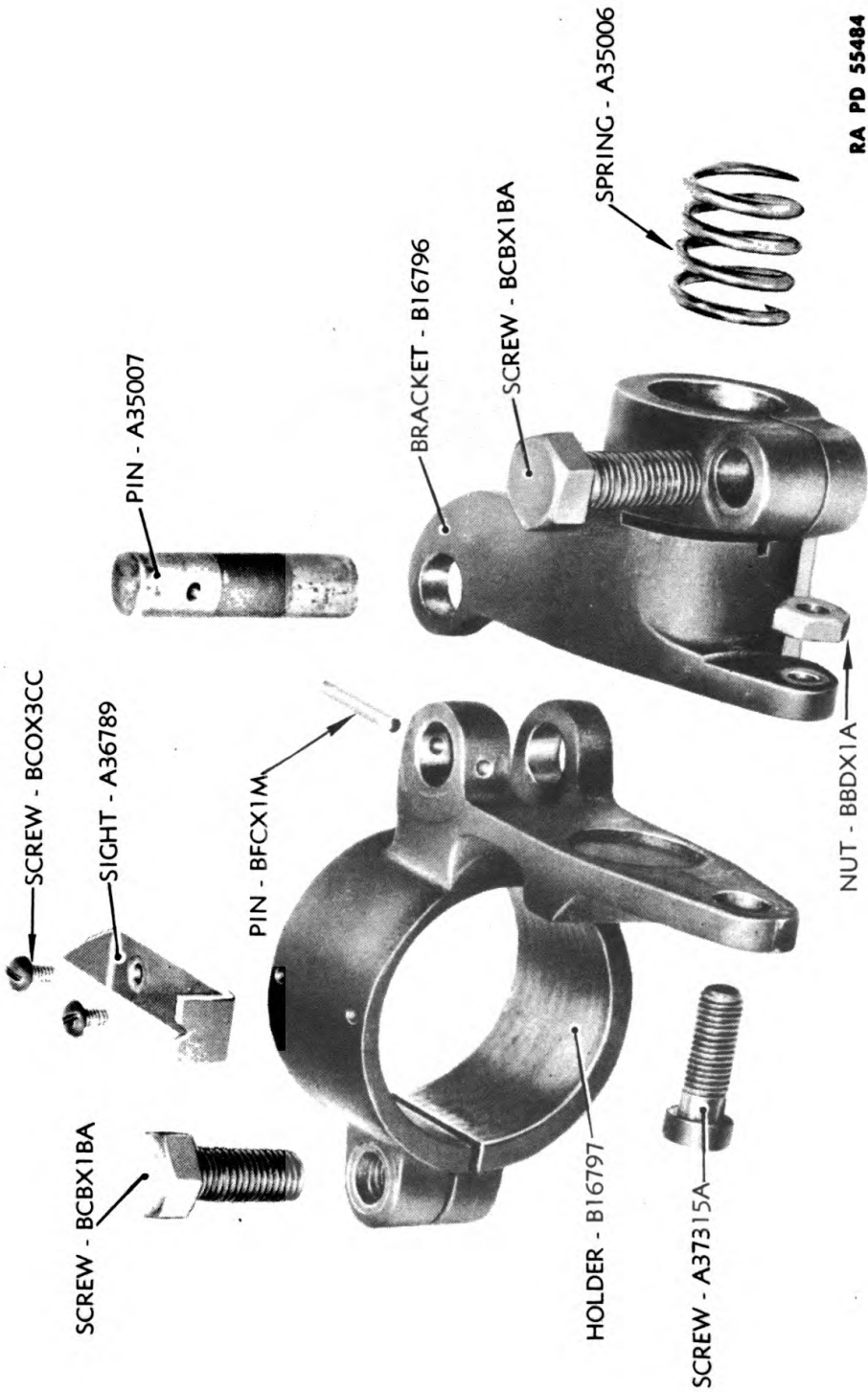


Figure 81 — Removal Of Telescope Adapter Assembly

DISASSEMBLY AND ASSEMBLY



RA PD 55484

Figure 82 — Adapter Disassembled

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RA PD 55485

Figure 83—Telescope M3**b. Eyepiece.**

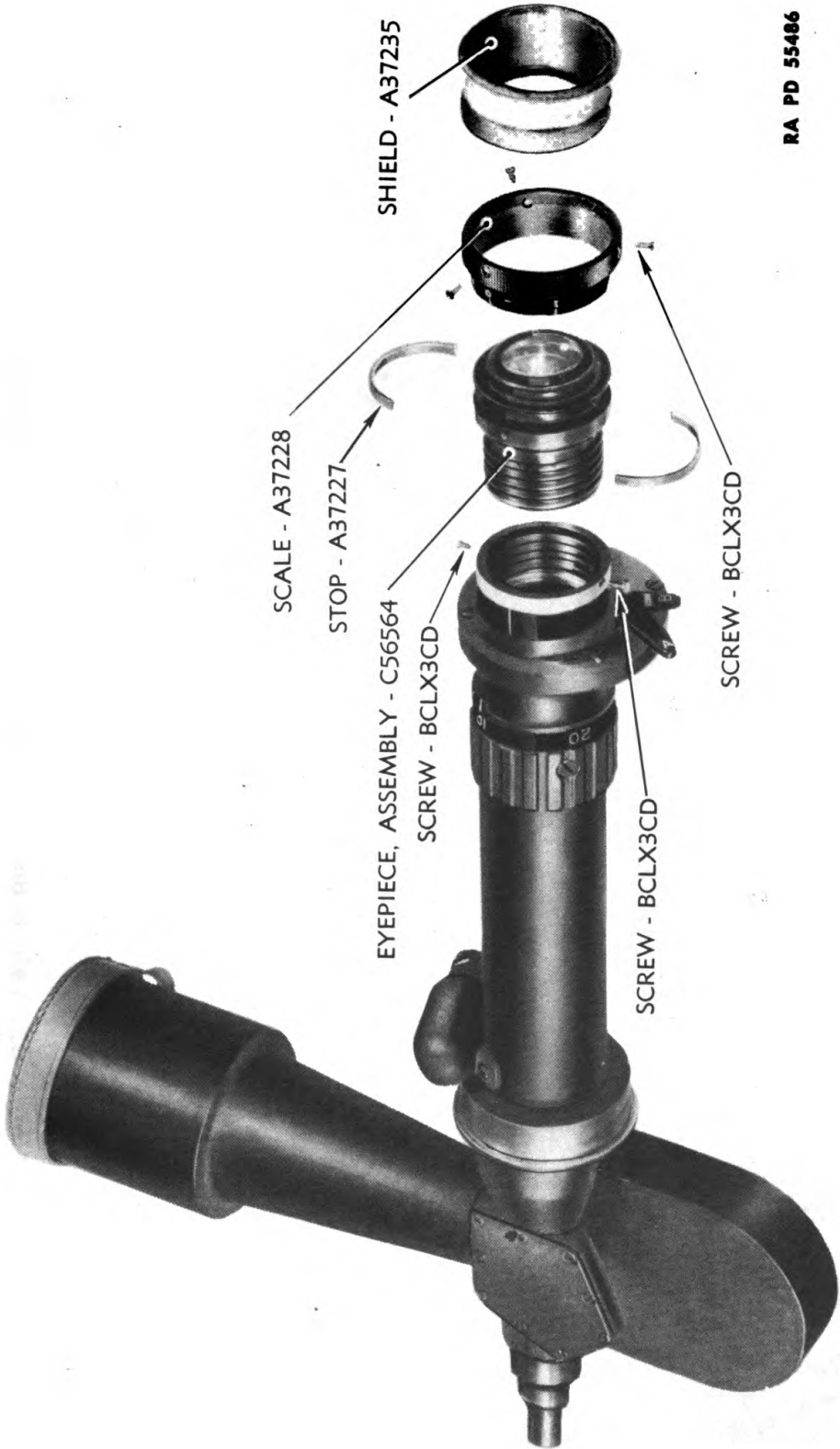
(1) To remove the eyepiece assembly C44325 or C56564 (fig. 84), first pull the rubber eyeshield A37235 radially outward at one point, stretch it over the retaining shoulder, and work around the circumference in this way. Withdraw the 3 screws BCLX3CD and slide the diopter scale A37228 off the eyepiece assembly.

(2) Remove the 2 screws BCLX3CD which retain the 2 halves of the stop A37227. Unscrew the eyepiece assembly, catching the stops as they slide out and remove the eyepiece assembly.

(3) To disassemble the eyepiece assembly C44325 where available, mark the position of cell A37226 with respect to cell A37230. Unscrew cell A37226 carefully to avoid damage to eyelens A37239 which turns with the cell and is held in it by sealing compound. Carefully slide the separator A37225, lens A37238, separator A37224, and lens A37237 out of the cell A37230, noting the position for reassembly.

(4) To disassemble the eyepiece assembly C56564 (figs. 84 and 85) where available, mark the position of cell A37226 with respect to cell A44084. Unscrew cell A37226 carefully to avoid damage to eyelens A44087 which turns with the cell and is held in it by sealing compound.

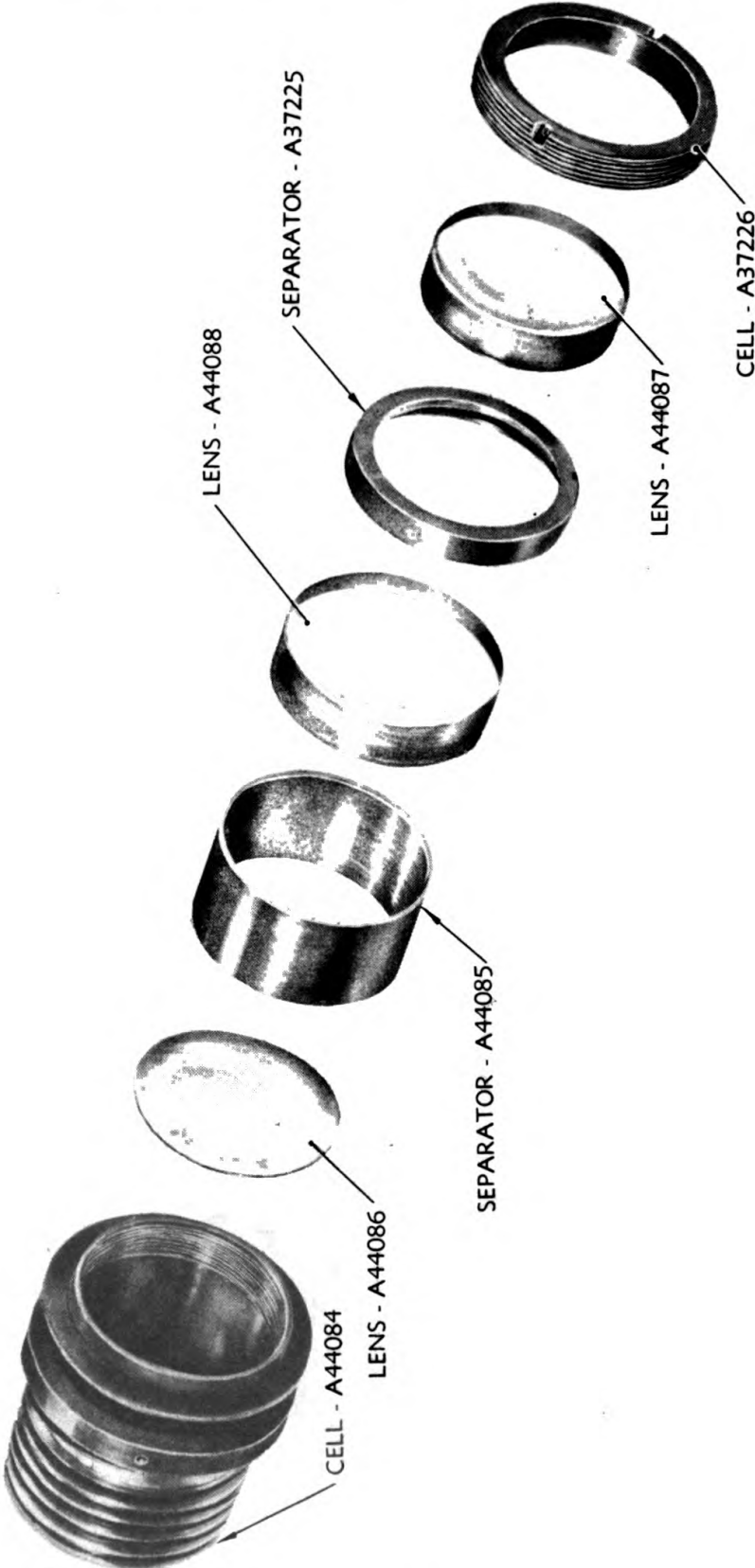
DISASSEMBLY AND ASSEMBLY



RA PD 55486

Figure 84—Telescope M3—Removal Of Eyepiece Assembly

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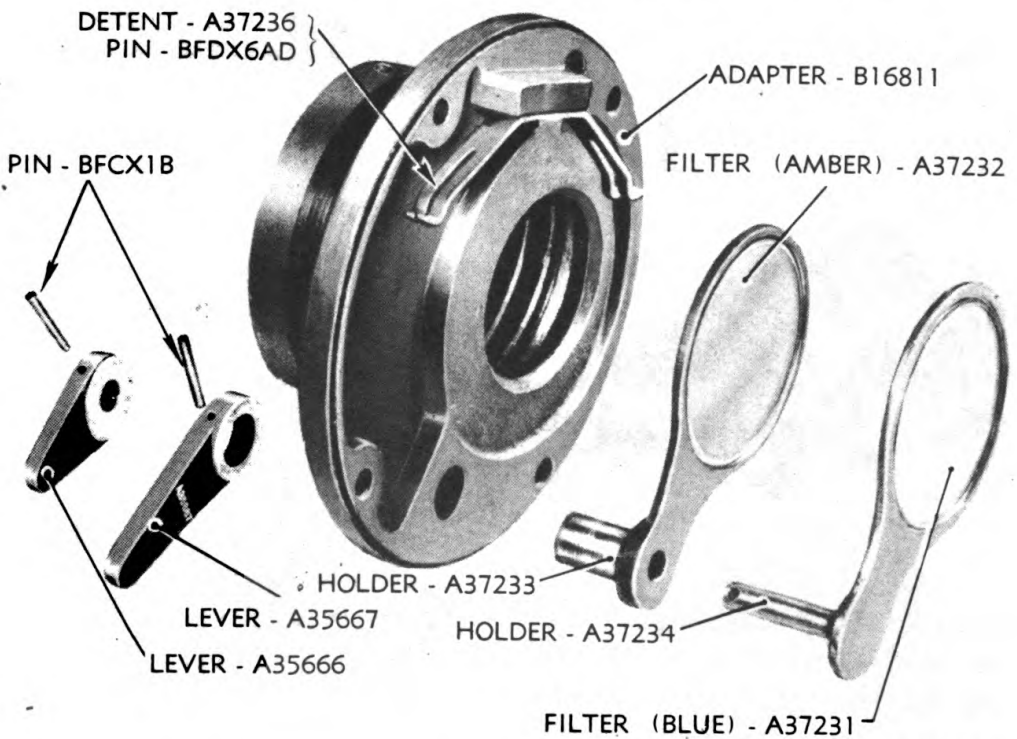
Figure 85—Telescope M3—Eyepiece Assembly Disassembled

DISASSEMBLY AND ASSEMBLY



RA PD 55488

Figure 86—Telescope M3—Removal Of Eyepiece Adapter



RA PD 55489

Figure 87—Telescope M3—Removal Of Ray Filter Assemblies

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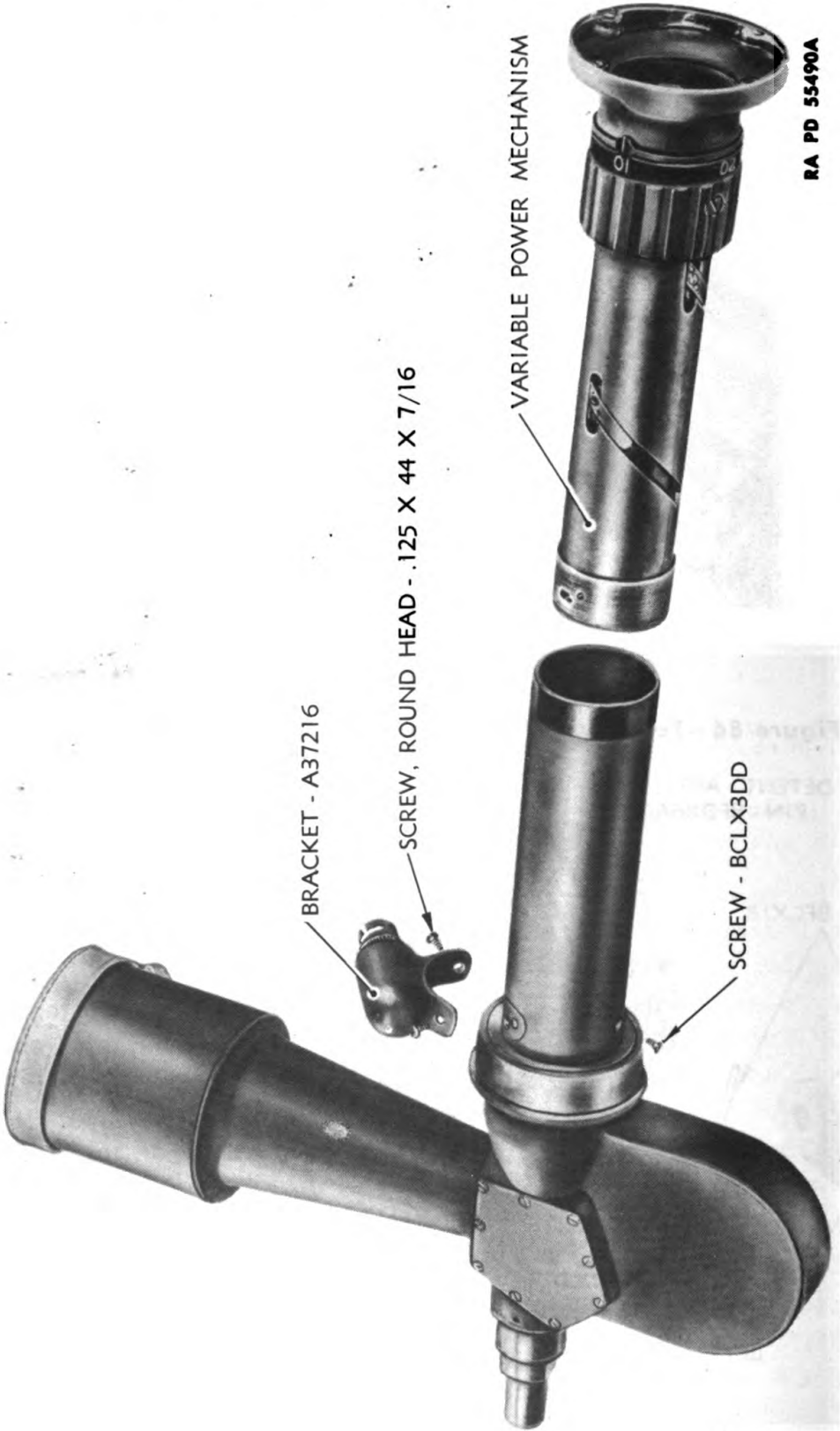


Figure 88—Telescope M3—Removal Of Cam Tube And Lamp Bracket

DISASSEMBLY AND ASSEMBLY

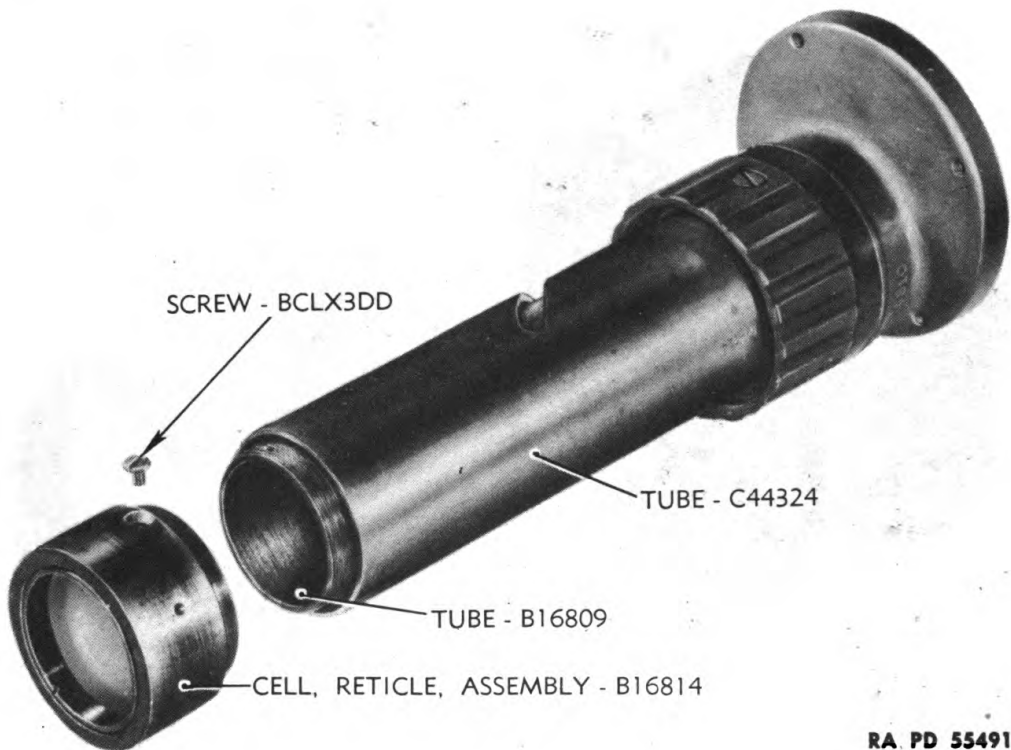


Figure 89—Telescope M3—Removal Of Reticle Assembly

Carefully slide the separator A37225, lens A44088, separator A44085, and lens A44086 out of the cell 44084, noting the position for reassembly.

c. Eyepiece Adapter.

(1) To remove the eyepiece adapter B16811 (fig. 86), unscrew the 4 fillister head screws BCGX3EG.

(2) To remove the ray filter assembly B16813 drive out the taper pin BFCX1B (fig. 87) and pull off lever A35666. Drive the taper pin BFCX1B and pull off lever A35667. Slide out the amber filter assembly A37232 and blue filter assembly A37231.

(3) The detent A37236 is riveted to the adapter and is not to be disassembled except for replacement.

(4) The filters are spun into the filter assemblies and are not to be disassembled.

d. Removal Of Variable Power Mechanism. Remove the screw BCLX3DD (fig. 88) nearly opposite the reticle window and the 2 screws BCDX3CF which secure the reticle lamp bracket. Grasp the housing B16810 and carefully pull the variable power mechanism out of the body tube B16808 of the telescope. In reassembly, guide the mechanism in

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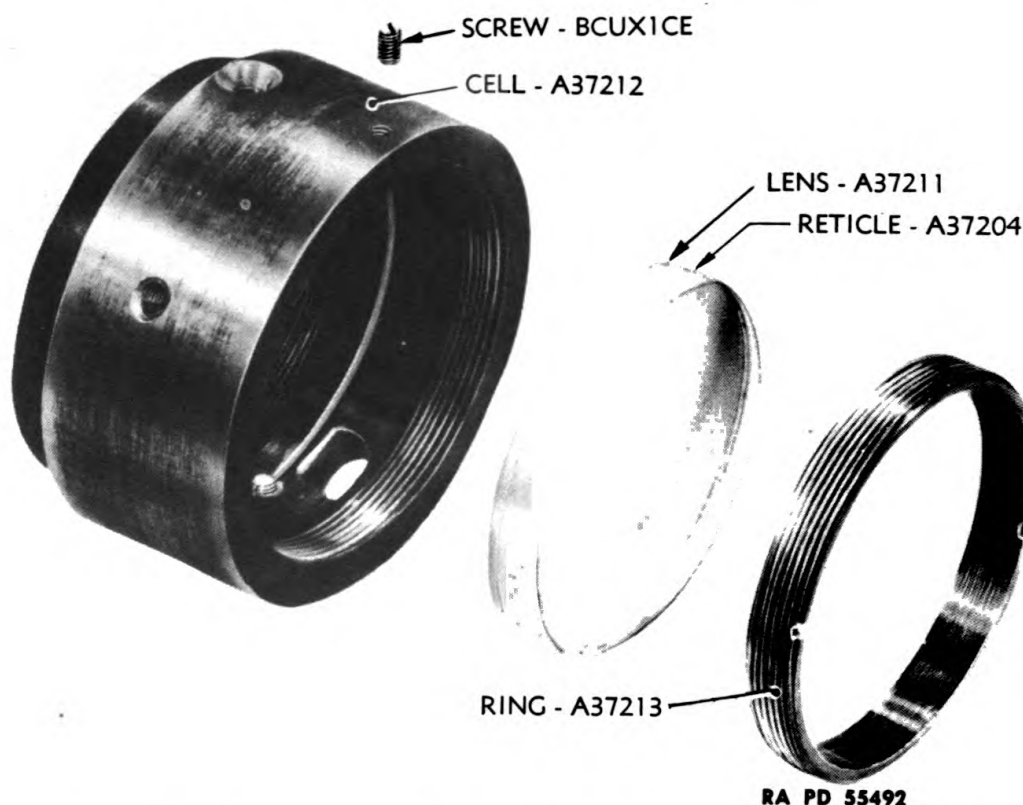


Figure 90—Telescope M3—Reticle Cell Assembly Disassembled

carefully to avoid change to the focusing sleeve A37229 or the sleeve A37223.

e. Disassembly Of Variable Power Mechanism.

(1) **REMOVAL AND DISASSEMBLY OF RETICLE ASSEMBLY.** To remove the reticle assembly B16814 (fig. 89), remove the flat-head screw BCLX3DD and unscrew the reticle assembly from the erecting lens tube B16809. To disassemble the reticle assembly loosen the locking screw BCUX1CE and remove the ring A37213. Remove the reticle A37204 (fig. 90).

(2) **REMOVAL OF ERECTOR CELLS.** Set the magnification to 10 power. This aligns the shoes, A37219 with A37220 and A37217 with A37218 (fig. 91), with clearance holes in the erecting lens tube B16809 and cam tube C44324. Remove the screws BCLX3CC and BCLX3CE and shoes and slide the cells out of the erecting lens tube B16809 (fig. 92).

(3) **DISASSEMBLY OF ERECTOR CELLS.** Remove the retaining rings A37215 (fig. 93) and the erector lenses A37214 from the cells A37221.

(4) REMOVAL OF ERECTING LENS TUBE.

(a) Unscrew the 3 screws BCLX3EE and slide the focusing sleeve A37229 (fig. 95) off the sleeve A37223.

DISASSEMBLY AND ASSEMBLY

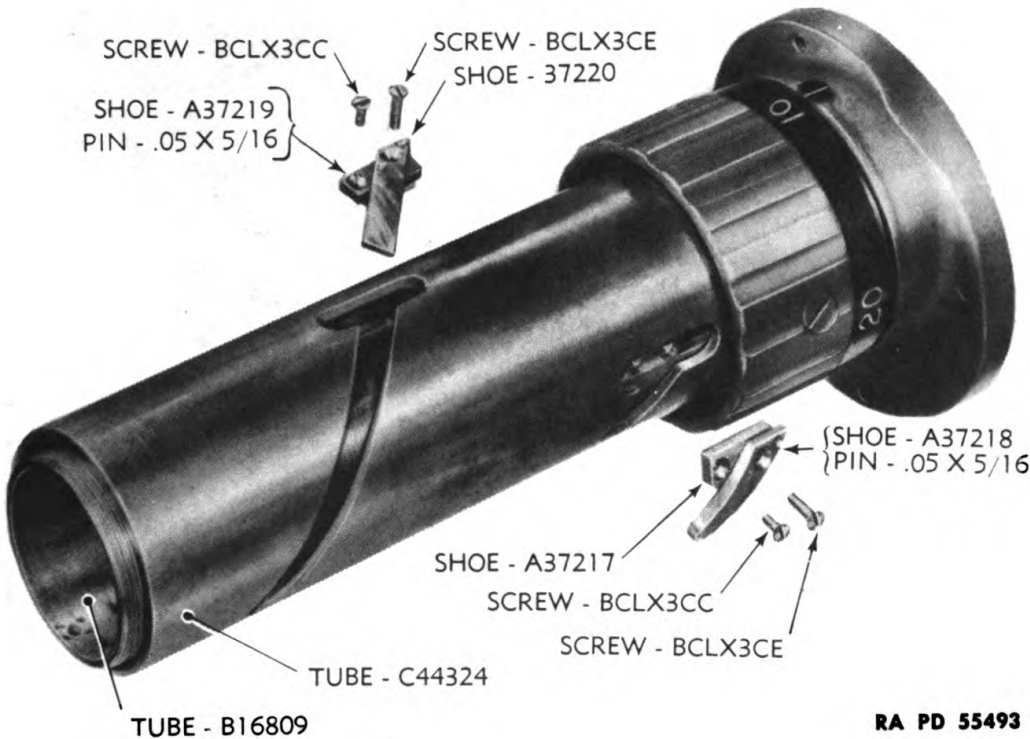


Figure 91—Telescope M3—Variable Power Mechanism Disassembled

(b) Slide the cam tube C44324 off the erecting lens tube B16809. If replacement is required, drive out the 3 pins BFDX6BB (fig. 96) which hold the sleeve A37223 and the bushing A37222 to the cam tube.

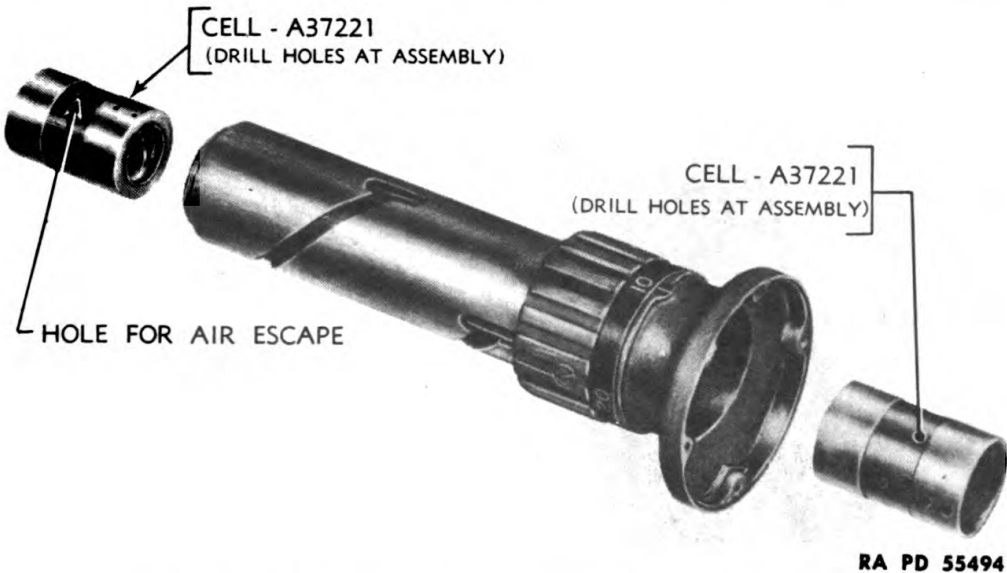


Figure 92—Telescope M3—Removal Of Erector Cell

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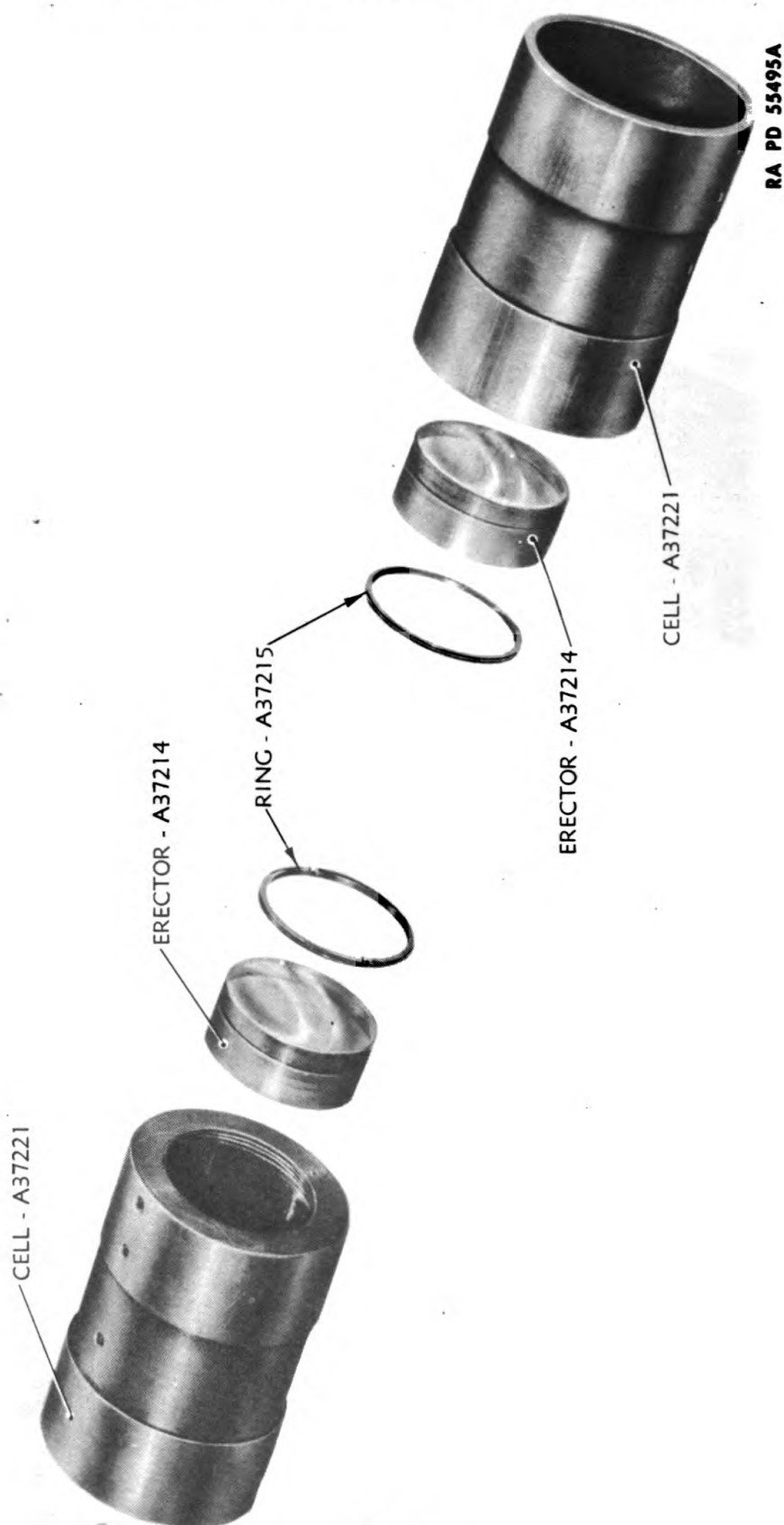


Figure 93—Telescope M3—Erector Cells Disassembled

DISASSEMBLY AND ASSEMBLY

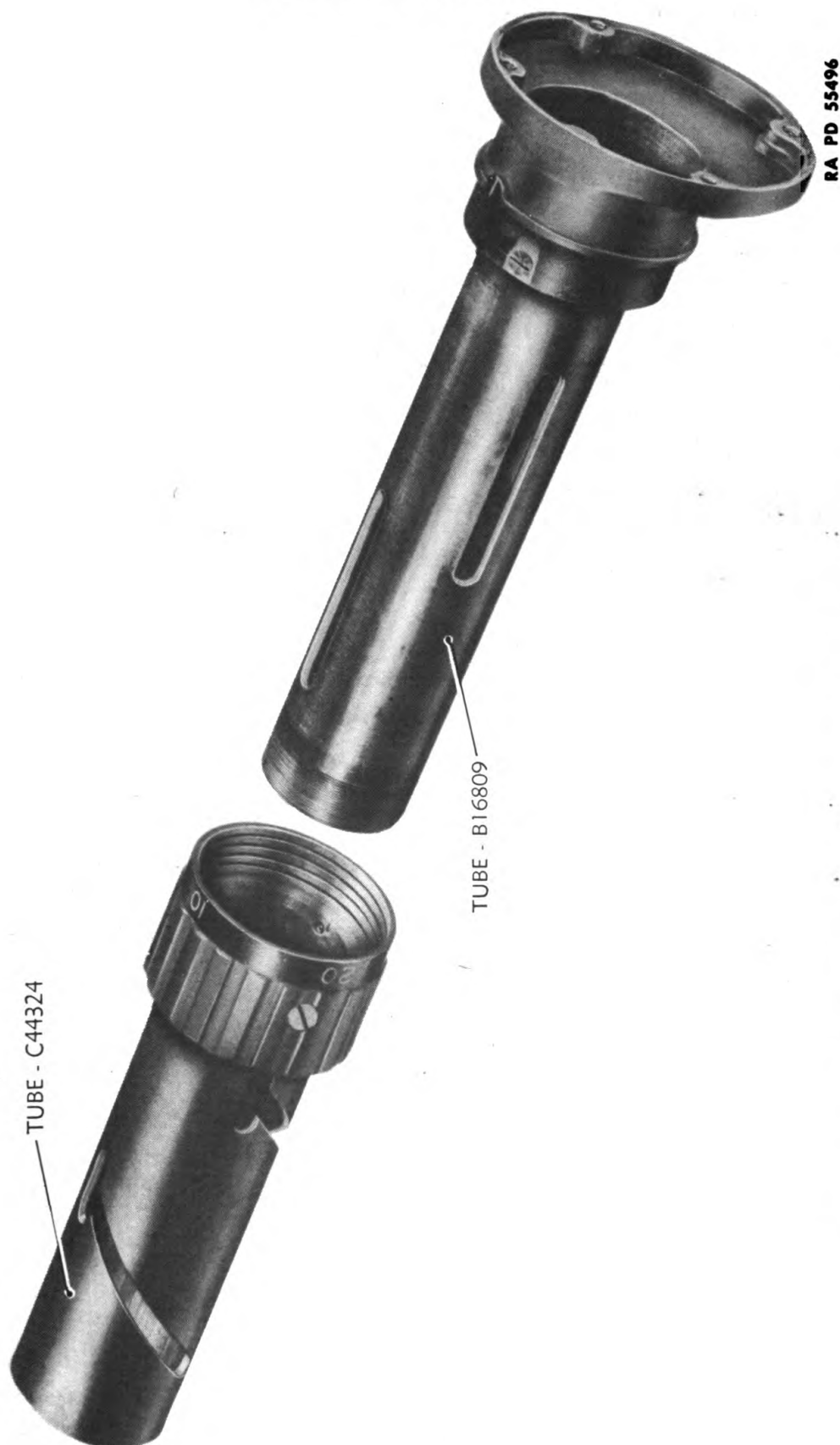


Figure 94—Telescope M3—Removal Of Erector Lens Tube From Cam Tube

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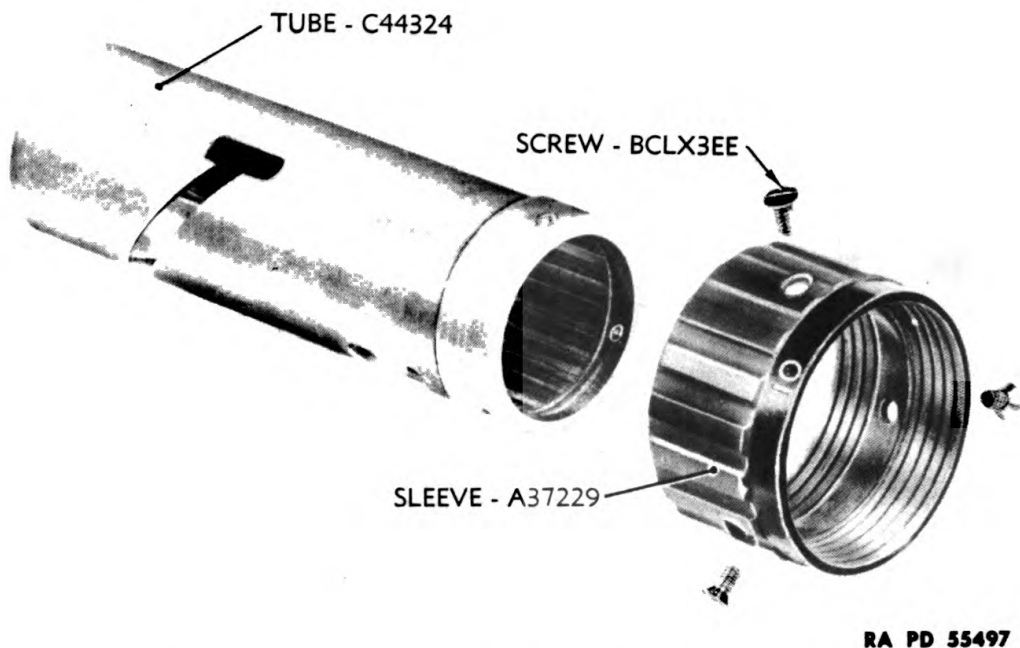


Figure 95—Telescope M3—Removal Of Focusing Sleeve

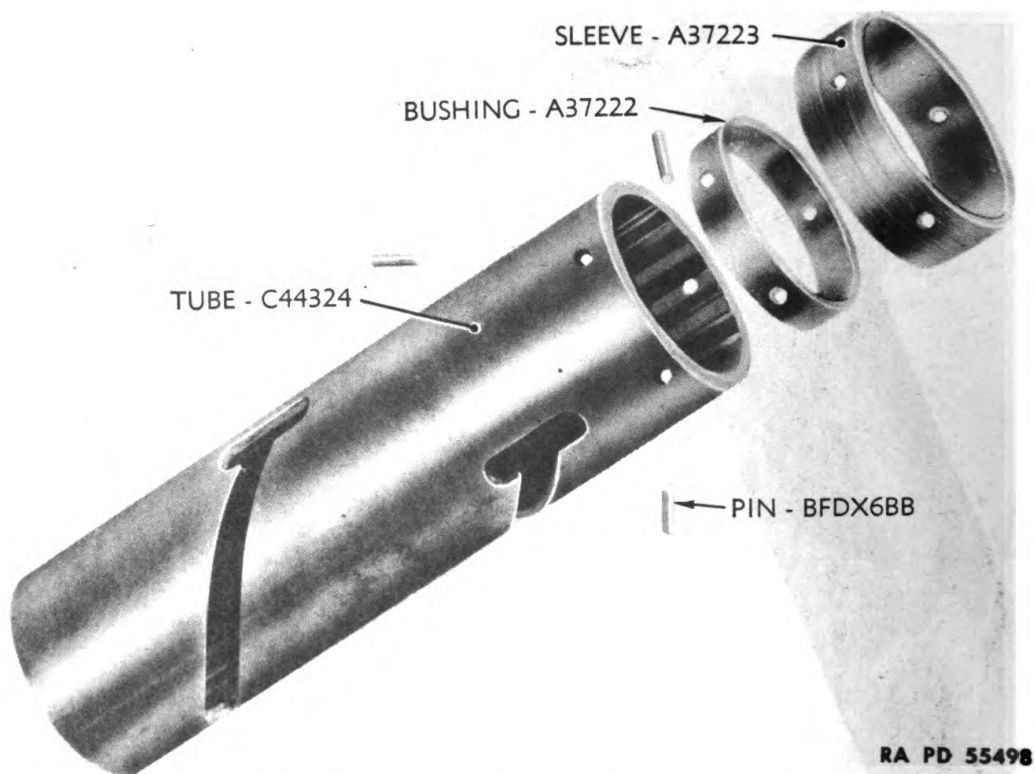
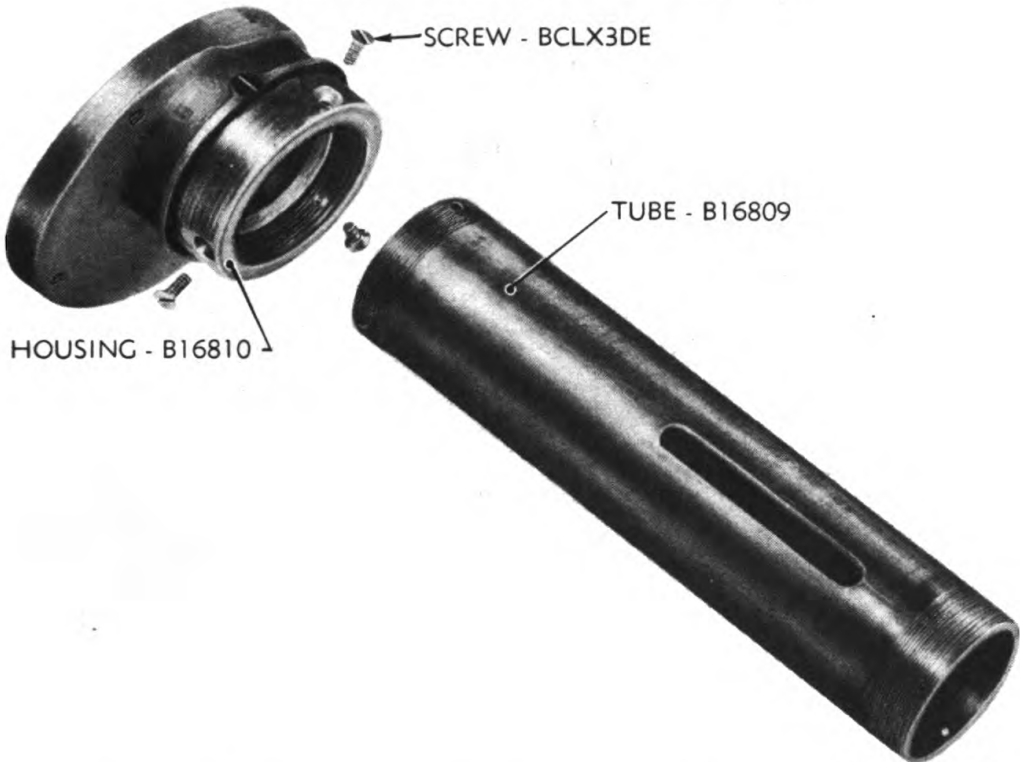


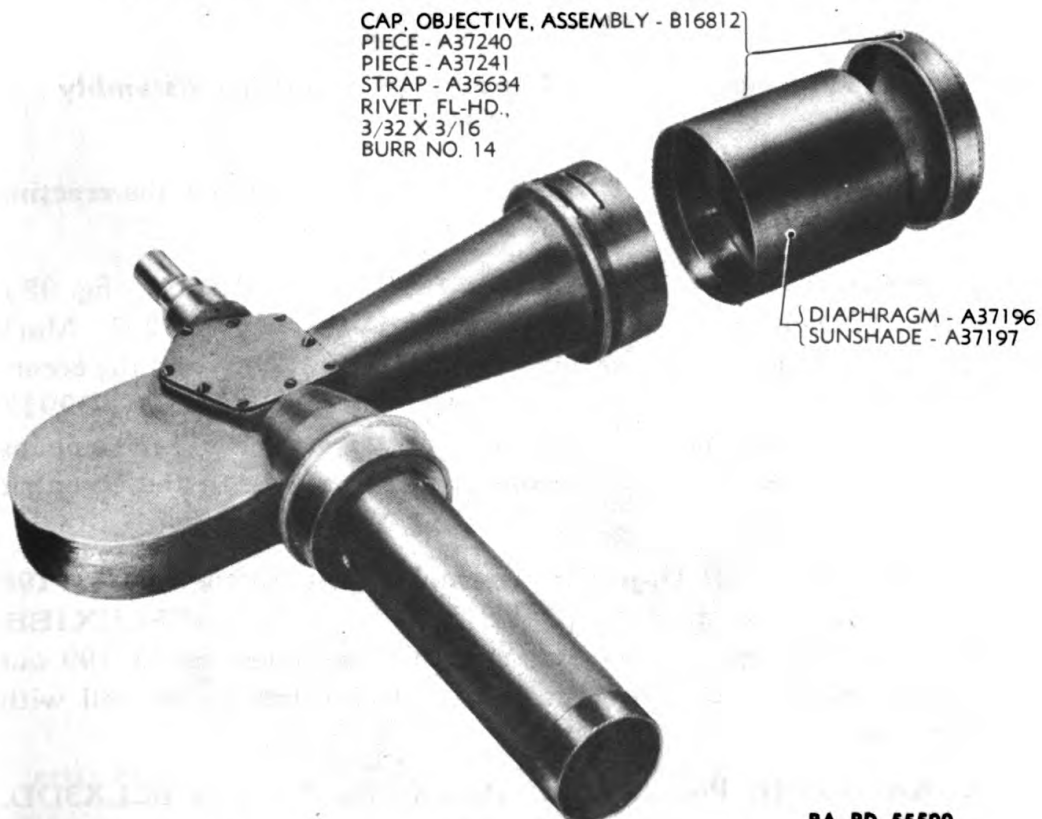
Figure 96—Telescope M3—Cam Tube Disassembled

DISASSEMBLY AND ASSEMBLY



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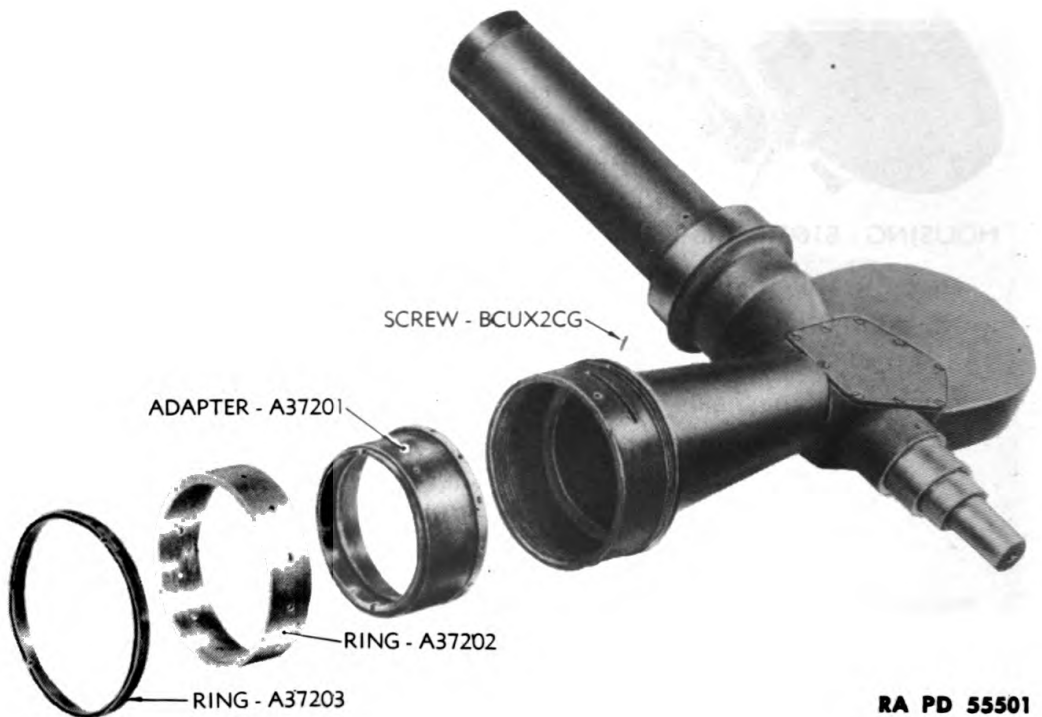
Figure 97 - Telescop M3 - Removal Of Filter Housing



RA PD 55500

Figure 98 - Telescop M3 - Removal Of Sunshade Assembly

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RA PD 55501

Figure 99—Telescope M3—Removal Of Objective Assembly And Eccentric

(c) Remove 3 screws BCLX3DE (fig. 97), and unscrew the erecting lens tube B16809 from the housing B16810.

f. **Removal Of Objective.** Unscrew the sunshade A37197 (fig. 98). Remove the lock screw BCUX2CG. Unscrew the ring A37203. Mark the positions of the objective assembly B173435 (fig. 100) and the eccentric ring A37202 (fig. 99) with respect to the telescope body D9917. The slots in the body may be used as access holes for turning and shifting the objective assembly. Pull the objective assembly and the eccentric ring out of the body.

g. **Disassembly Of Objective Assembly.** Unscrew the cell A37198 (fig. 100) from the adapter A37201. Remove the screw BCUX1BB, unscrew the retaining ring A37200, and push the objective A37199 out of the cell A37198. In reassembly seal the objective in the cell with sealing compound.

h. **Removal Of Penta Prism.** Remove the 9 screws BCLX3DD, cover A37207, and pad A37242 (fig. 102). Pull out the wedge A37210

DISASSEMBLY AND ASSEMBLY

RA PD 55502

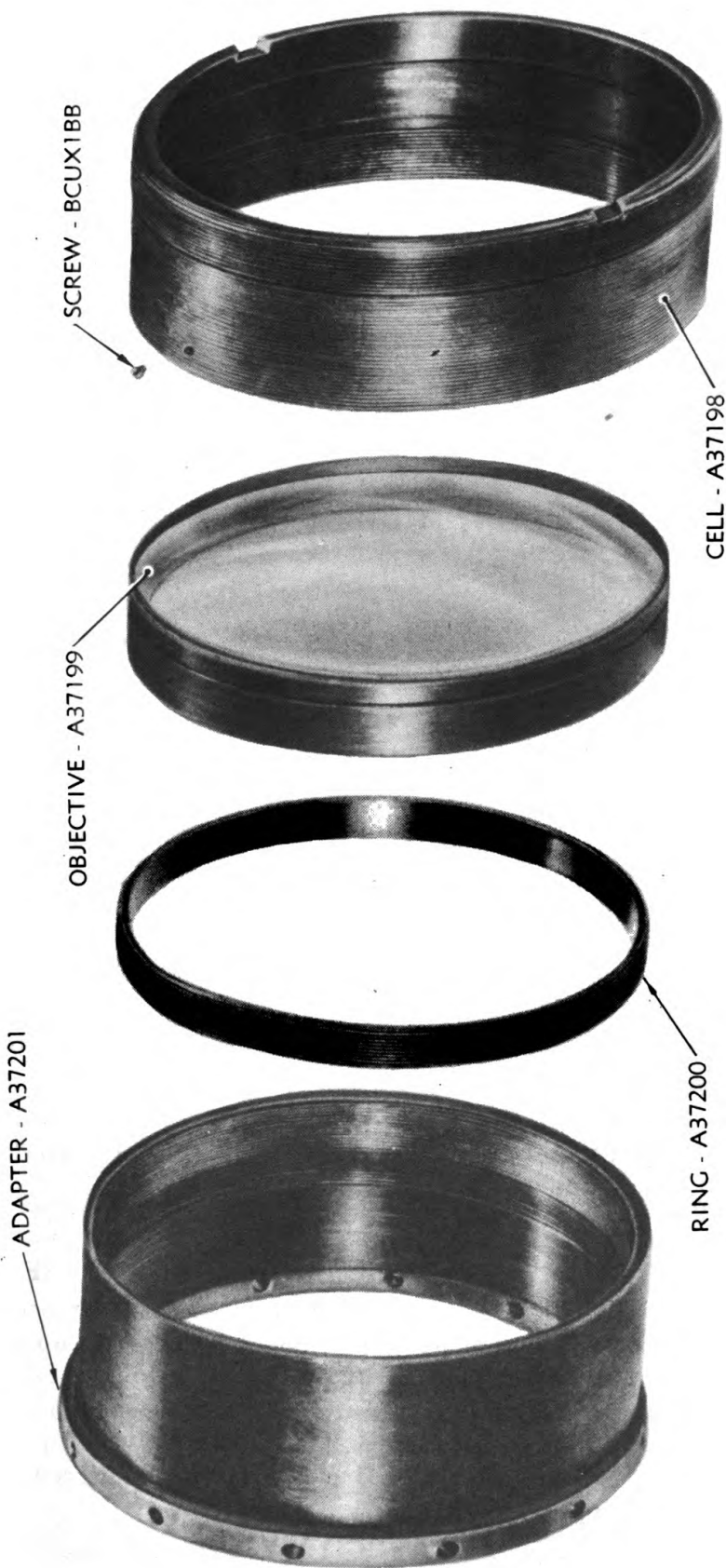


Figure 100—Telescope M3—Objective Assembly Disassembled

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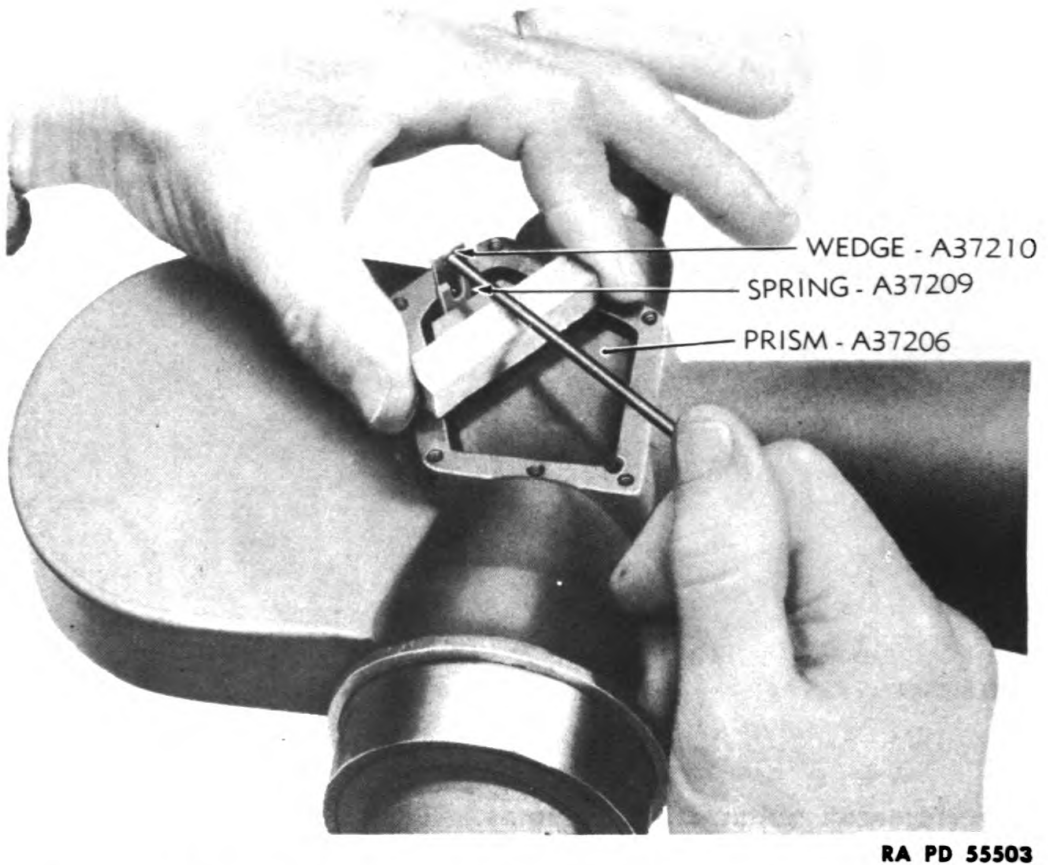


Figure 101—Telescope M3—Penta Prism—Removing Wedge

and the prism spring A37209 (fig. 101). Lift out the penta prism A37206. In reassembly seal the cover and body with sealing compound.

39. DISASSEMBLY OF ELBOW TELESCOPE M2 (figs. 103 to 109).

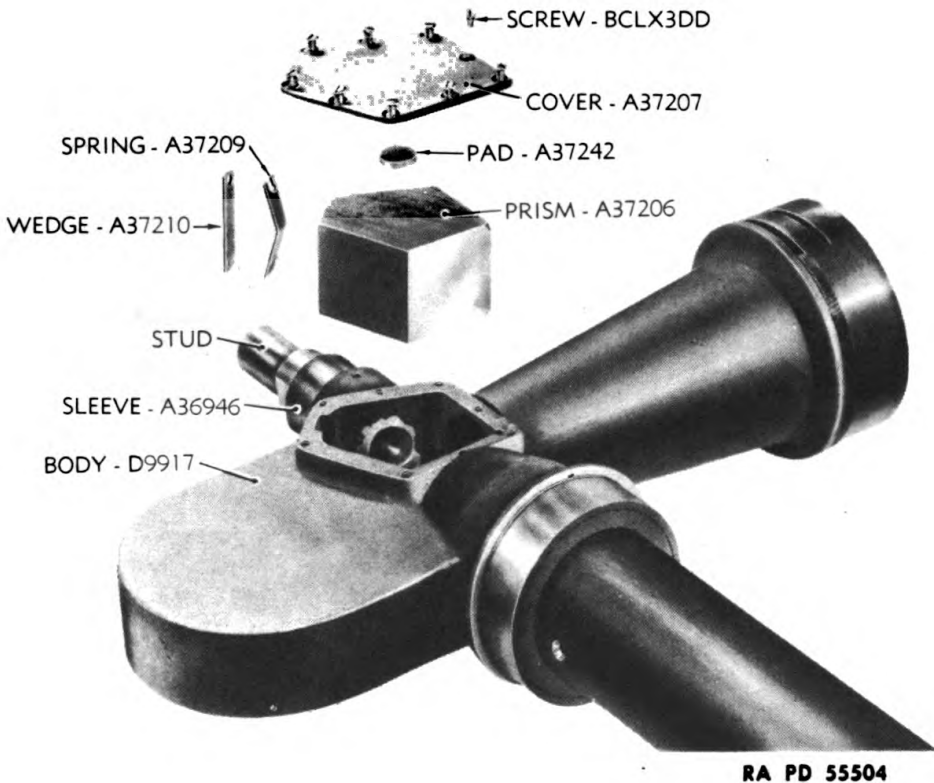
a. Removal Of Lamp Bracket. Remove the rubber eyeshield (fig. 103) by pulling it free of the ridge on which it seats. Remove the lamp bracket B129316 by loosening the 2 screws BCGX3FF which clamp it to the telescope body and slide it over the eyepiece. In reassembly, make sure that the bracket slopes downward away from the telescope body for protection against rain.

b. Removal And Disassembly Of Eyepiece Assembly.

(1) Remove the screw BCUX1CB (fig. 104) and unscrew the eyepiece assembly C44414.

(2) Remove the screw BXUX1CC (fig. 105) and unscrew the retaining ring A33912. Carefully withdraw the eyelens A33915, separator

DISASSEMBLY AND ASSEMBLY



RA PD 55504

Figure 102—Telescope M3—Penta Prism Disassembled

A33917, collective lens A33914, separator A33916, and field lens A33913.

c. Removal And Disassembly Of Reticle Assembly.

(1) Remove the reticle assembly B137650 (fig. 105), after loosening 2 adjacent screws BCUX1CC of the 4 used for adjustment.

(2) Disassemble the reticle cell by unscrewing the ring A33910 (fig. 106) locked by screw BCUX3AA. Carefully withdraw the reticle A33909 from its cell A33908. Avoid touching the reticle with the fingers.

d. **Removal of Amici Prism.** Unscrew the 2 covers A33904 (fig. 107), each locked by screw BCUX1CC. Keep the spring shaped holder A37820 from shifting, and drive out the wedge A37821. Remove the holder and the prism A36234. If the cork pad A32820 on the prism is damaged it should be replaced.

e. Removal And Disassembly Of Objective Assembly.

(1) Unscrew the objective assembly B137648 (fig. 108) after removing the locking screw BCLX3CC.

(2) Disassemble the objective assembly by unscrewing ring A33907 locked to cell A33905 by screw BCUX1CB. Remove the objective A33906.

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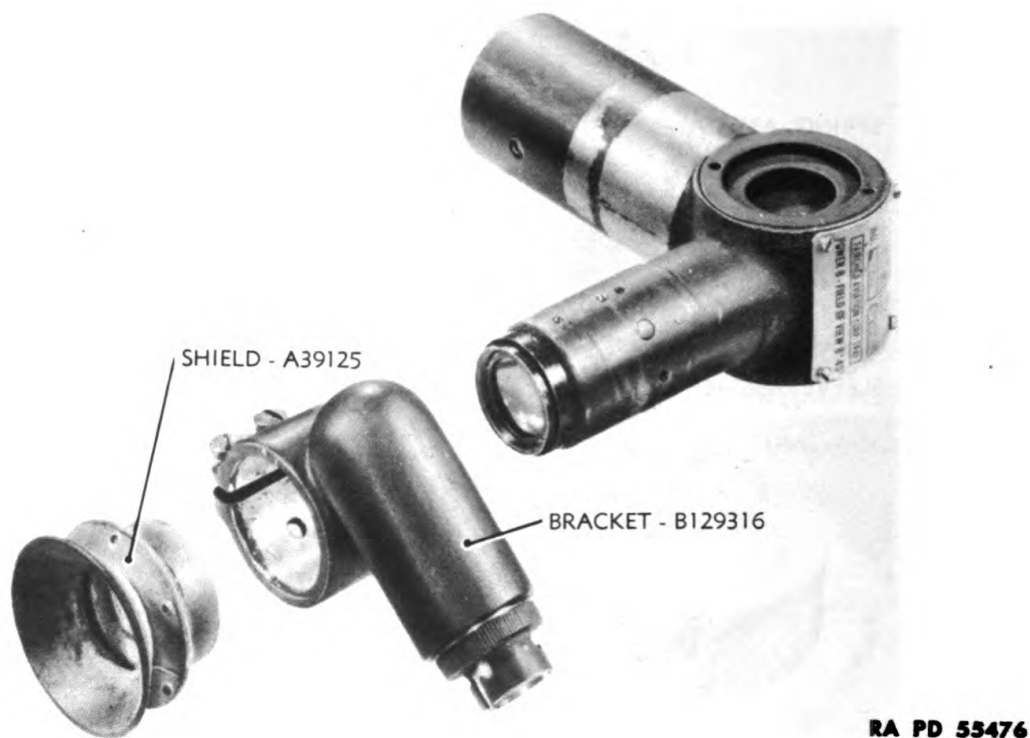
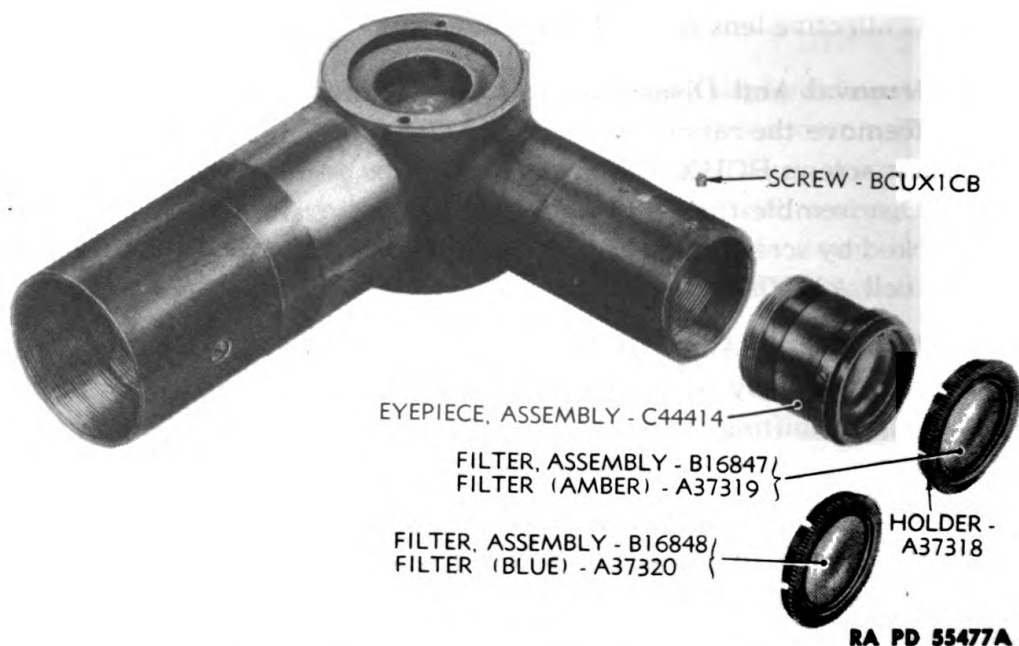
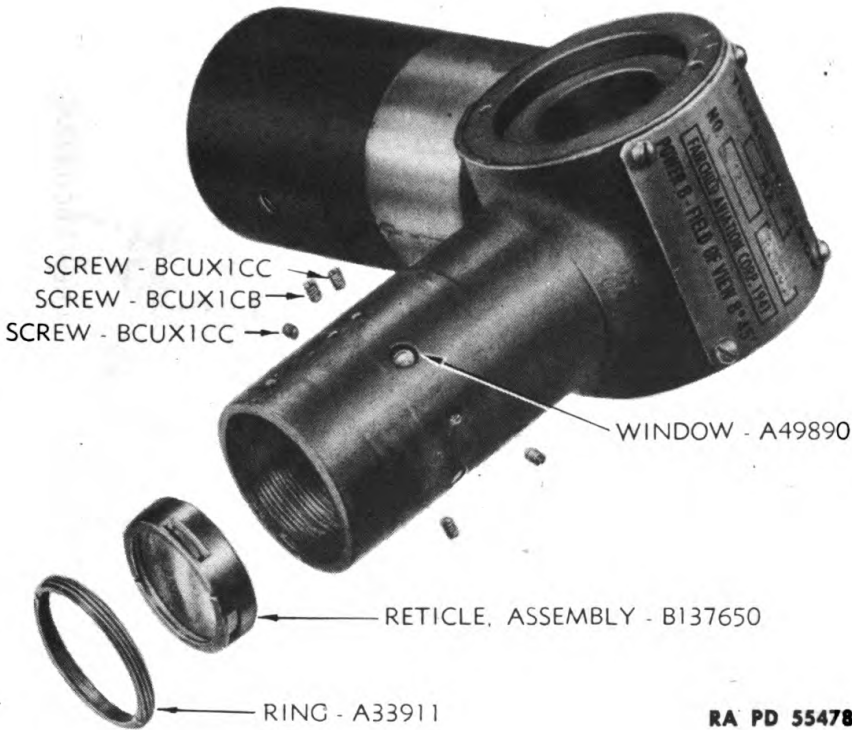


Figure 103—Elbow Telescope M2—Removal Of Lamp Bracket And Eye Shield



**Figure 104—Elbow Telescope M2—Removal Of Eyepiece
Assembly Showing Filters**

DISASSEMBLY AND ASSEMBLY



RA PD 55478

Figure 105—Elbow Telescope M2—Removing Reticle Cell

40. ASSEMBLY.

a. Assembly is performed in the reverse order of disassembly. Necessary adjustments are performed as indicated in previous portions of this manual.

b. All parts which have been removed from the instrument should be carefully cleaned before assembly.

(1) Optical elements should be cleaned with ethyl alcohol, or liquid lens cleaning soap. Care must be exercised to prevent excess alcohol from coming in contact with the edges of compound lenses, in order to prevent damage to the lens cement which is soluble in alcohol. If pencil marks have been placed on the unpolished surfaces of lenses or prisms, avoid removing them to prevent difficulty when assembling. Polish the optical element gently with lens paper. Remove dust and dirt with an air bulb and a small clean camel's-hair brush, or liquid lens cleaning soap.

(2) Metal components should be cleaned in dry-cleaning solvent and quickly dried in air.

ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
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Figure 106—Elbow Telescope M2—Reticle Cell, Objective Cell, And Light Socket Disassembled

DISASSEMBLY AND ASSEMBLY

RA PD 55480

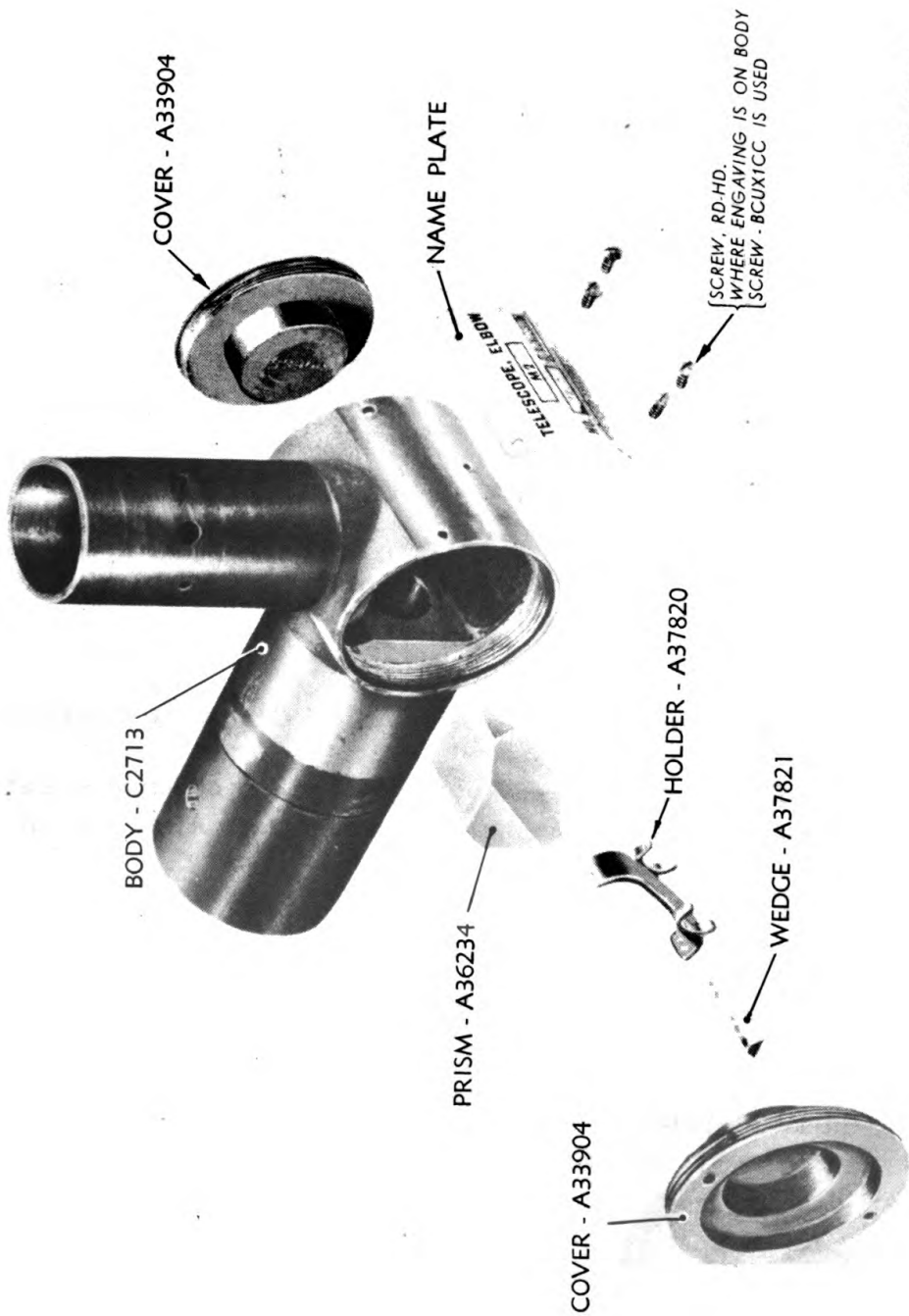
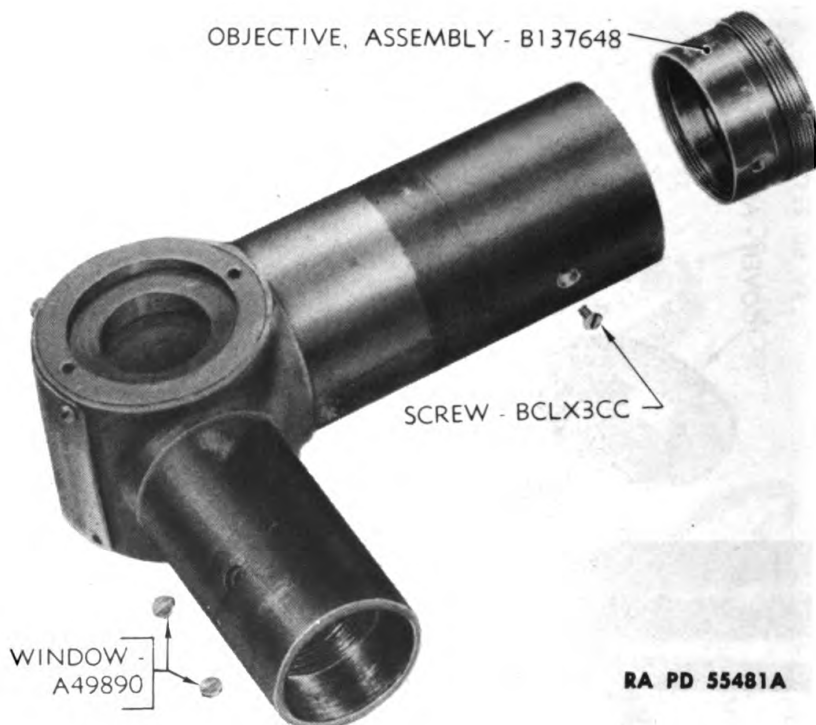


Figure 107 — Elbow Telescope M2 — Removal Of Amici Prism

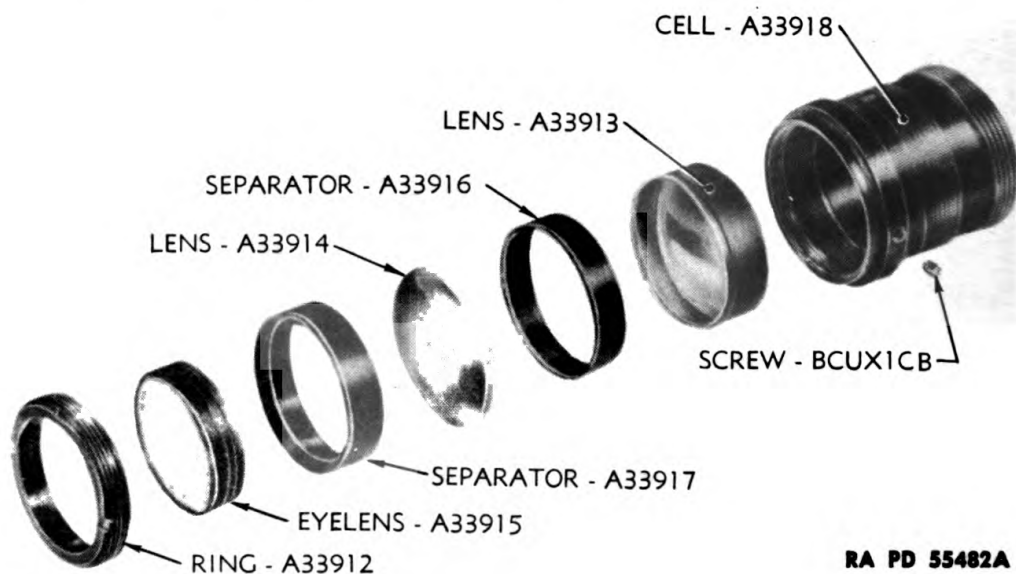
**ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
COMMANDER'S OBSERVATION INSTRUMENT M1**



RA PD 55481A

Figure 108—Elbow Telescope M2—Removal Of Objective Assembly

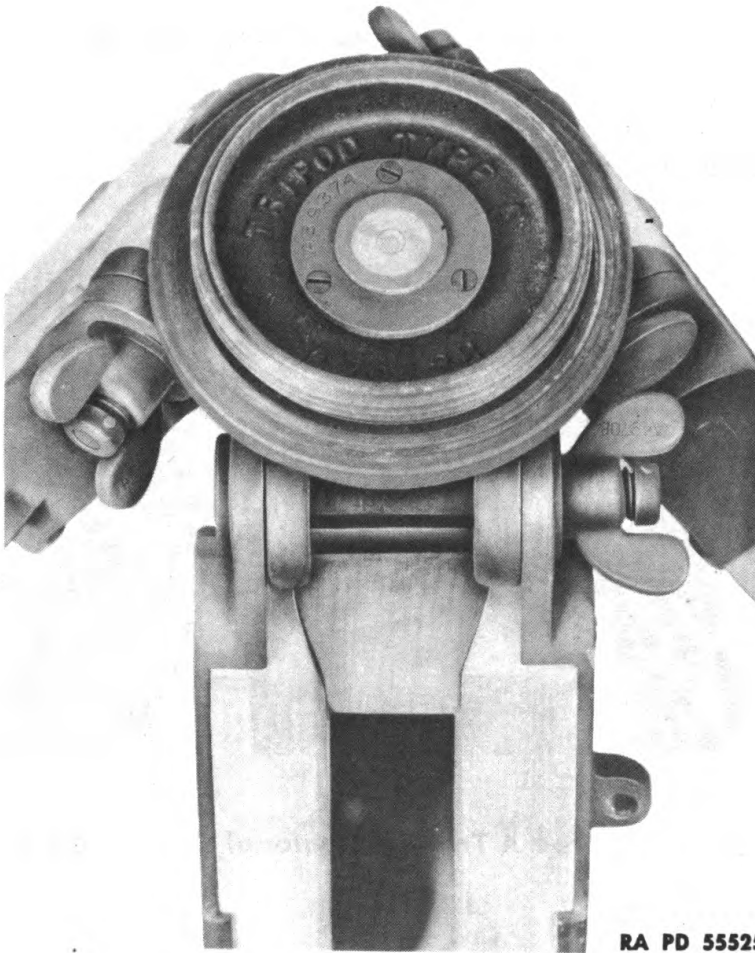
CAUTION: *Do not clean metal components in dry-cleaning solvent when the optical elements have not been removed. After cleaning,*



RA PD 55482A

Figure 109—Elbow Telescope M2—Eyepiece Assembly Disassembled

DISASSEMBLY AND ASSEMBLY



RA PD 55525

Figure 110—Type A Tripod Showing Type C Circular Level

lubricate worms, worm gears, and similar moving parts by applying a light coating of grease.

c. When replacing the eyepiece and objective cells of the elbow telescopes, apply a *very light* film of grease to the threaded portion of the cell. The grease film facilitates assembly and is effective in sealing the telescope. There should be just enough grease to make the joint air- and moisture-tight, but not enough to overrun onto the lenses (par. 41).

d. Plug the recesses above the various adjusting screws, etc., with plugging cement of the same color as the instrument. Smooth the cement to hide the openings as completely as possible (par. 41).

e. After assembly and adjustment, the various parts and mechanisms should be inspected according to the procedure given in section V.

**ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
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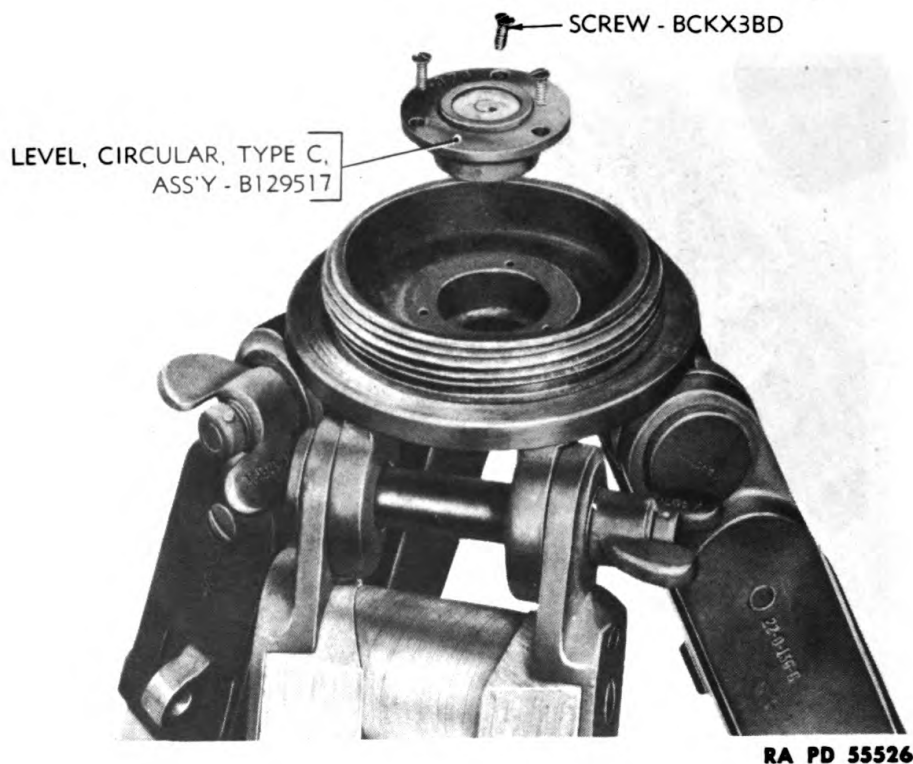
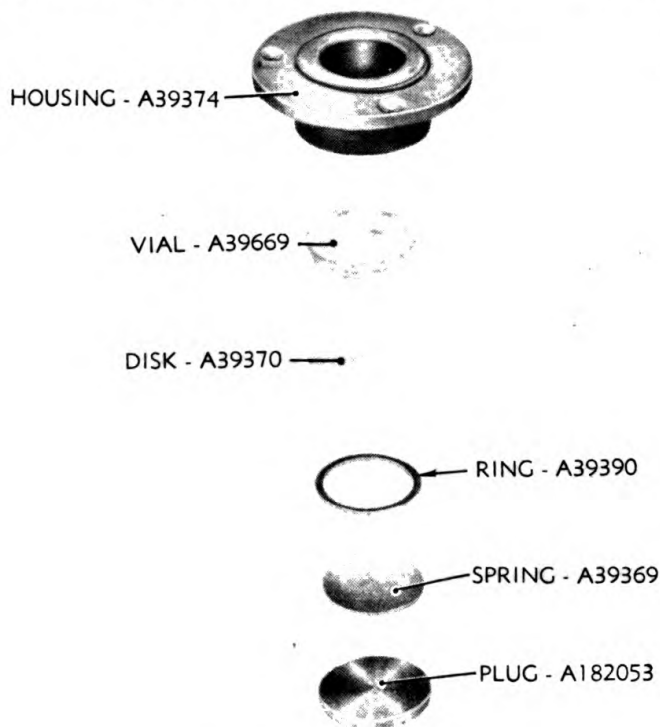


Figure 111—Type A Tripod—Removal Of Circular Level



RA PD 55527

Figure 112—Type A Tripod—Circular Level Disassembled

DISASSEMBLY AND ASSEMBLY

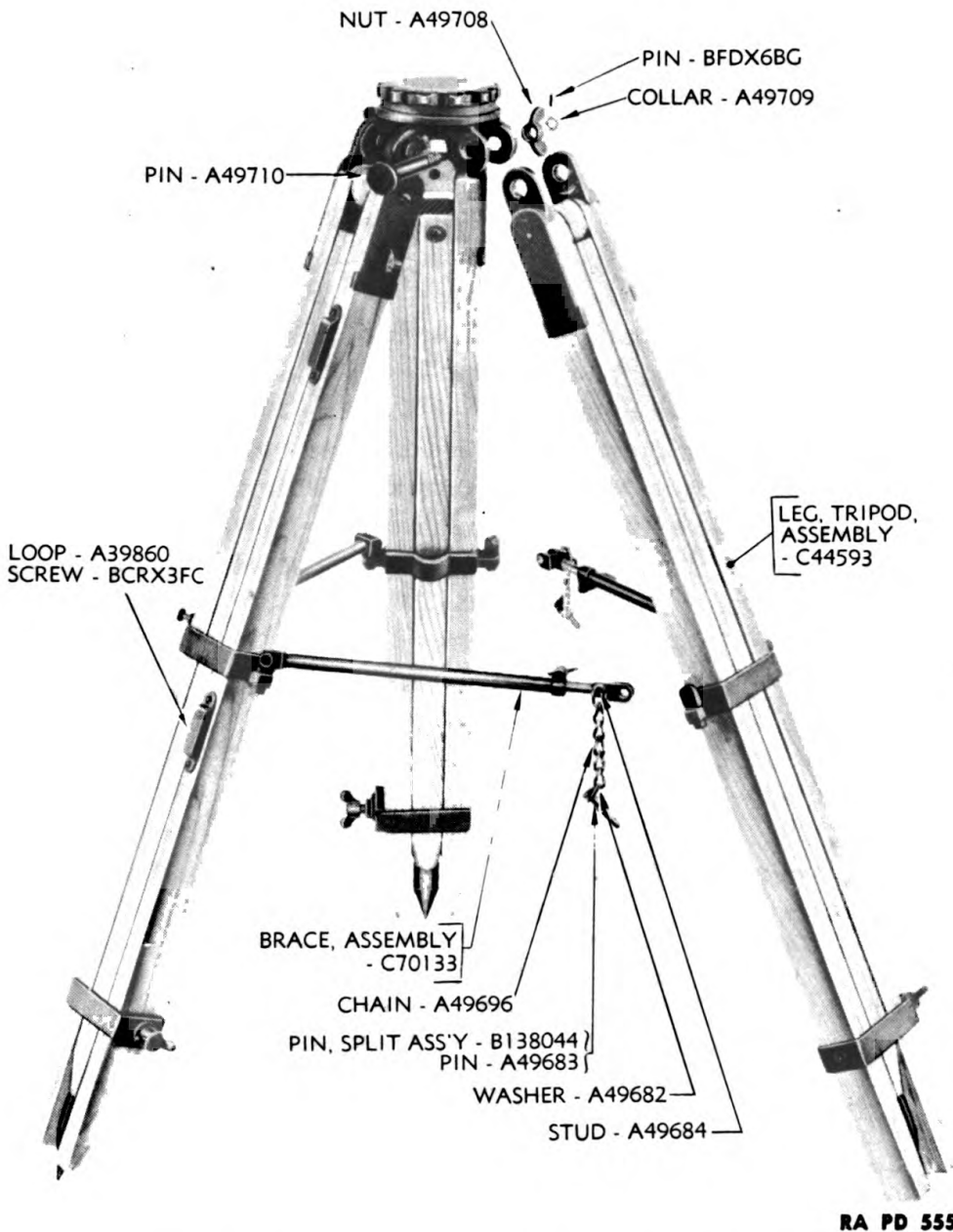
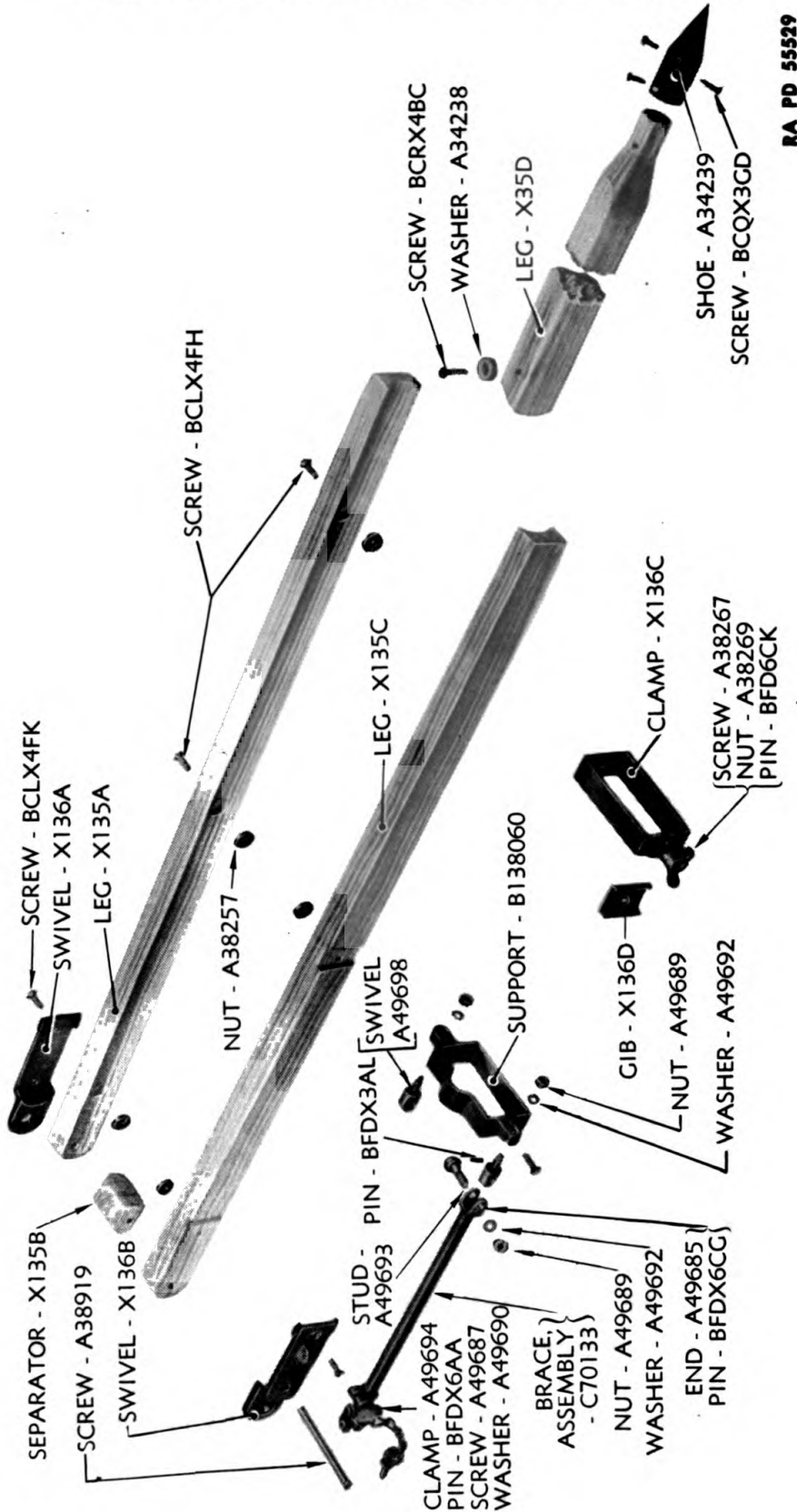


Figure 113—Type A Tripod—Removing One Leg

41. SEALING AFTER ASSEMBLY.

a. To protect the interior from dust, moisture, and dirt, all joints, apertures, and screwheads of telescopes should be sealed after reassembling. The serviceable life of the telescope is greatly increased by proper sealing. This sealing operation should be performed by one who is familiar with the functioning of the instrument and with the sealing preparations.

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RA PD 55529

Figure 114—Type A Tripod—Leg Disassembled

DISASSEMBLY AND ASSEMBLY

b. There are several preparations commonly used for sealing. Each has a specific use.

(1) **PLASTELINA.** Plastelina is used on parts where handling is at a minimum. It remains soft a long time. Plastelina should be used only when a more effective sealing compound is not available.

(2) **PLUGGING CEMENT.** Plugging cement is used to plug the recesses above the heads of various adjusting screws. This cement affords a tight, moistureproof and dustproof seal and dries to an exceedingly hard consistency.

(3) **BLACK NAVY SEALING COMPOUND.** This compound is used to seat and seal lenses and other optical components in their cells. This preparation must be used carefully. Used to excess, it may smear and greatly harm the elements concerned. In extreme cases of over-application, the compound may eventually expand and crack the lenses it contacts. There should be just enough to make the lens airtight and moisture-tight but not enough to overrun onto the lenses.

(4) **GREASE, SPECIAL, LOW TEMPERATURE.** This grease is an effective seal for threaded parts. The grease should be applied sparingly and care exercised that it does not come into contact with the optical components.

(5) **SHELLAC.** Shellac is used on screwheads. A drop or two under the head will give an effective seal. Shellac should never be used to seal threaded parts, or used on threads of any kind.

(6) **PAINT.** Paint has a secondary function for sealing the parts painted. Paint should never be relied upon to provide the complete seal of the parts concerned.

c. Sealing preparations should be used sparingly. Care should be exercised that the preparation does not come in contact with parts other than those intended.

42. INSPECTION.

a. Refer to the list of inspection requirements (par. 19) in a final check to make sure that the instrument is in proper working condition before reissue to the using troops.

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Section VIII

PAINTING

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Painting	43
Touch-up painting	44

43. PAINTING.

a. General.

(1) The painting of instruments must be supervised by someone familiar with the functioning of the instruments. Care should be exercised that no paint comes in contact with scales, gear teeth, bearings, bearing surfaces, and locating surfaces. The effect of paint on bearings and bearing surfaces is obvious. Ordnance materiel is painted before issue and from time to time, depending upon the service conditions and climatic conditions to which the materiel is subjected. The paint to be required will be governed by the instrument to be serviced. The exterior parts will be universally painted olive-drab.

(2) Proper painting adds to the general appearance and materially prolongs the serviceable life of the instrument by acting as a secondary sealing agent in preventing the entrance of dirt, dust, and moisture.

b. Preparing For Painting.

(1) All surfaces to be painted must be dry and free of dirt, oil, grease and rust. For cleaning use dry-cleaning solvent, and rinse with hot water. Dry in an air stream. It must be remembered that frequent washing of metal components in the same batch of solvent will soon render it unfit for further use, since it easily becomes saturated with grease, oil, and dirt. The solvent must be changed frequently.

(2) Remove loose paint around marred parts by rubbing those parts with No. 1 flint paper. Dust off all loose sand and paint flakes.

c. Painting.

(1) Apply the paint with a brush or spray gun. Exercise care to avoid splashing or spraying paint on parts which are not to be painted. Finished colors must match authorized or prescribed hues. Minor deviations of pigment proportions are permissible, if necessary to match colors.

(2) Use white scale filler for painting graduations. Clean the gradua-

PAINTING

tion marks and apply a thin coat of white filler. Wash off surplus filler with castile soap and water; rinse in clean water and dry.

44. TOUCH-UP PAINTING.

a. Small scratches or worn spots, as well as unavoidable blemishes caused by assembly or adjusting operations should be touched up with an air drying enamel of a practical color match of the original finish.

**ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
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Section IX

PACKING, STORAGE, AND SHIPMENT

Data Paragraph 45

45. DATA.

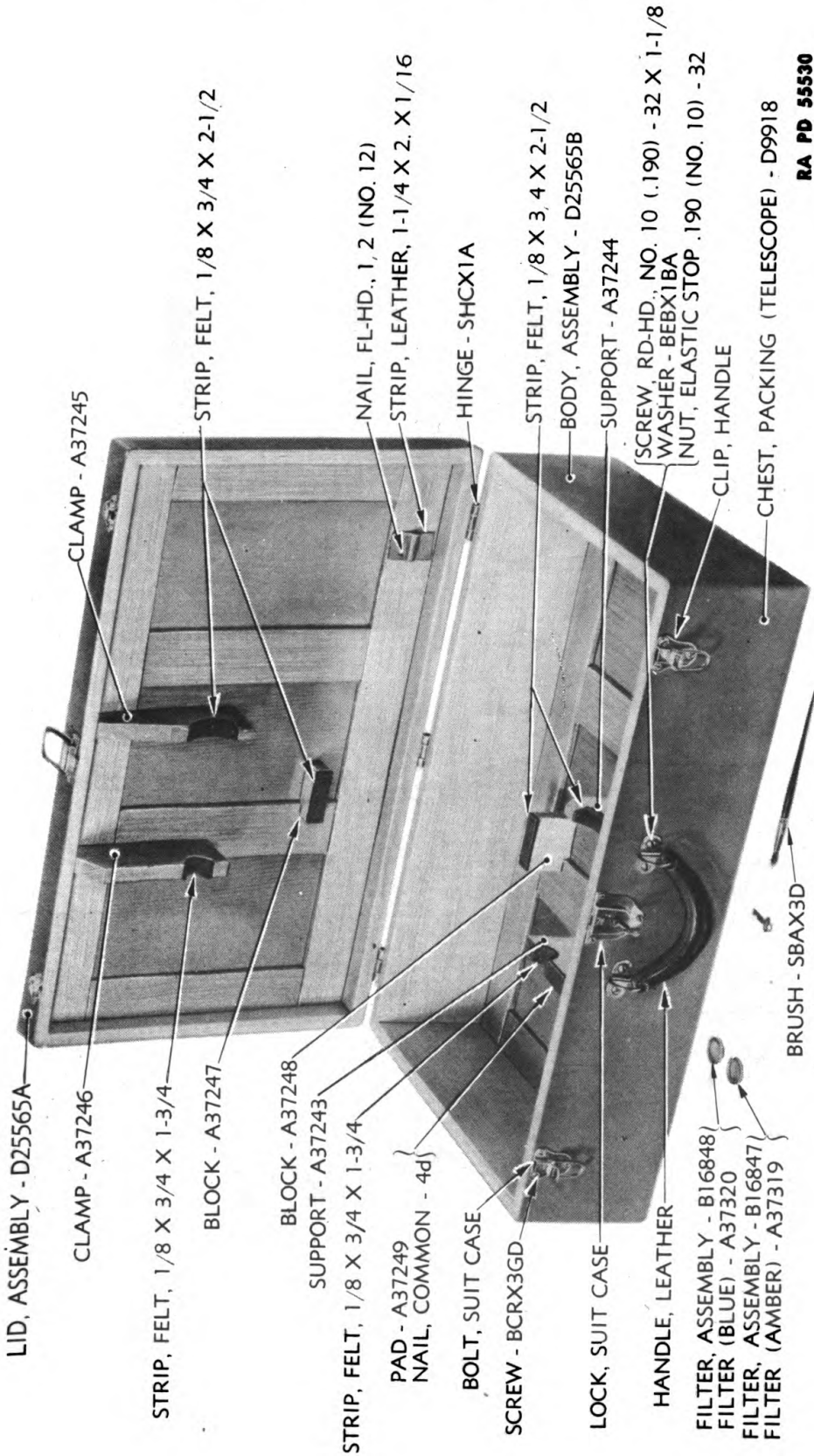
a. Instrument, observation, A.A., B.C., M1, complete, shipped in 2 chests and 2 crates (figs. 115 to 117) as follows:

SNL No.	Item	Piece Mark or Drg. No.	Item Weight
	SHIPPING CRATE No. 1, containing:	FB-16599	
F-58	1 chest, containing:	D9918	
F-58	1 Telescope M3	91-54	14.75 lb
F-58	1 Elbow Telescope M2	91-19	1.70 lb
	SHIPPING CRATE No. 2, containing:	FB-15969	
F-58	1 chest, containing:	D9884	
F-58	1 mount	22-187	24.2 lb
	SHIPPING CHEST No. 1, containing:	FB-15973	
F-101	1 Tripod, Type A	22-0-99	17.25 lb
	SHIPPING CHEST No. 2, containing:	FB-16617	
M-1	1 Battery Box, Type B4, w/contents	D9654	45. lb

Container Drg. No.	Type of Container	Items	Dimensions			Square Feet	Cubic Feet	Shipping Weight Loaded Containers
			Length	Width	Height			
FB-16599	Crate	1	2.48 ft	1.70 ft	0.77 ft	4.22	3.25	52 lb
D9918	Chest-A	1	2.33 ft	1.40 ft	0.63 ft	3.26	2.05	38 lb
FB-15969	Crate	1	1.60 ft	1.35 ft	1.50 ft	2.16	3.24	71 lb
D9884	Chest-A	1	1.17 ft	1.05 ft	1.35 ft	1.22	1.65	48 lb
FB-15973	Chest-R	1	1.52 ft	0.856 ft	0.54 ft	1.30	0.70	37 lb
FB-16617	Chest-R	1	2.13 ft	1.21 ft	0.79 ft	2.58	2.04	64 lb
D9654	Chest-A	1	1.52 ft	0.85 ft	0.625 ft	12.9	8.06	45 lb

b. Information on packing, storage, and shipment of Elbow Telescope M35 is not available at this time and will be included in a revision.

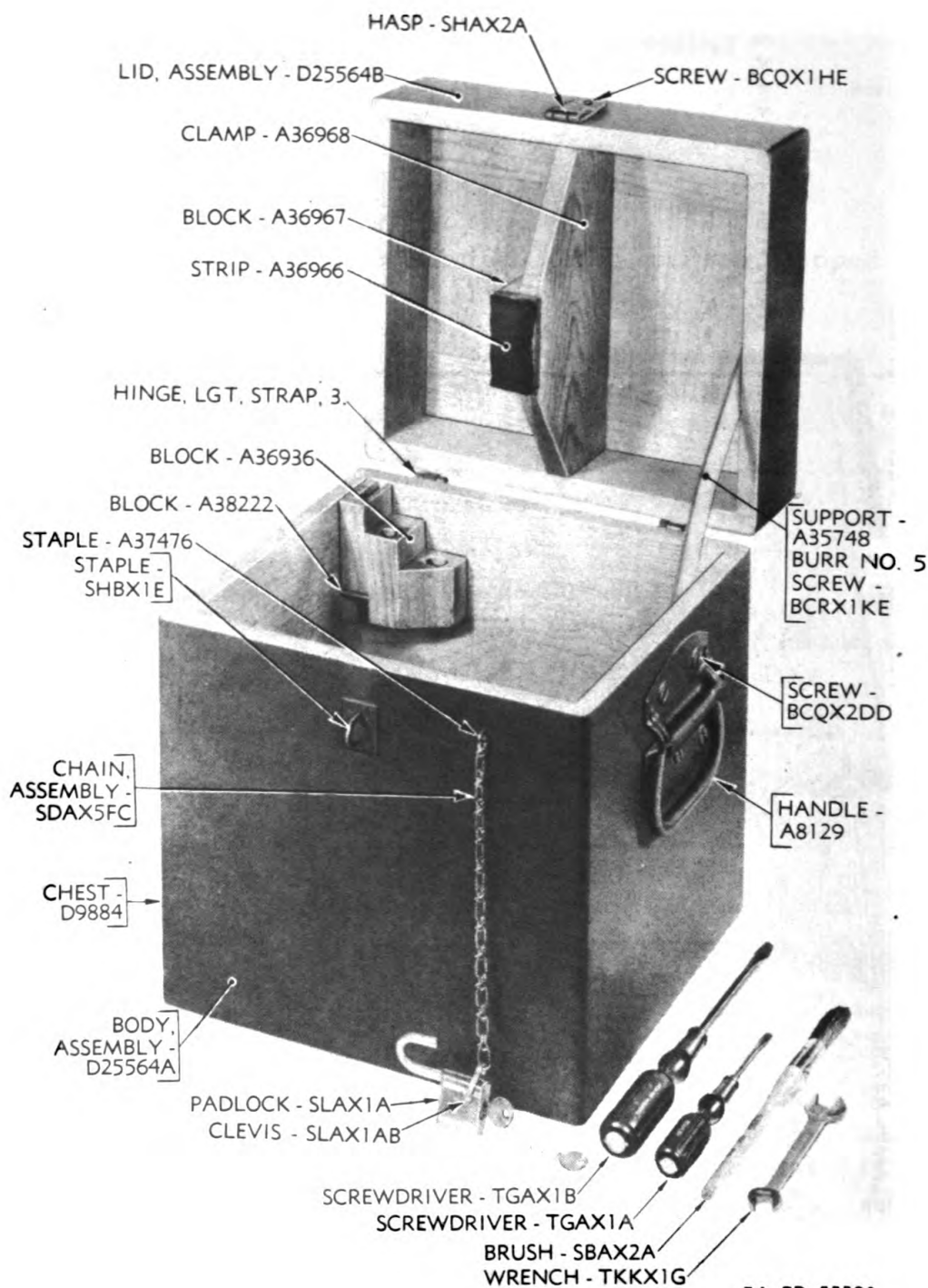
PACKING, STORAGE, AND SHIPMENT



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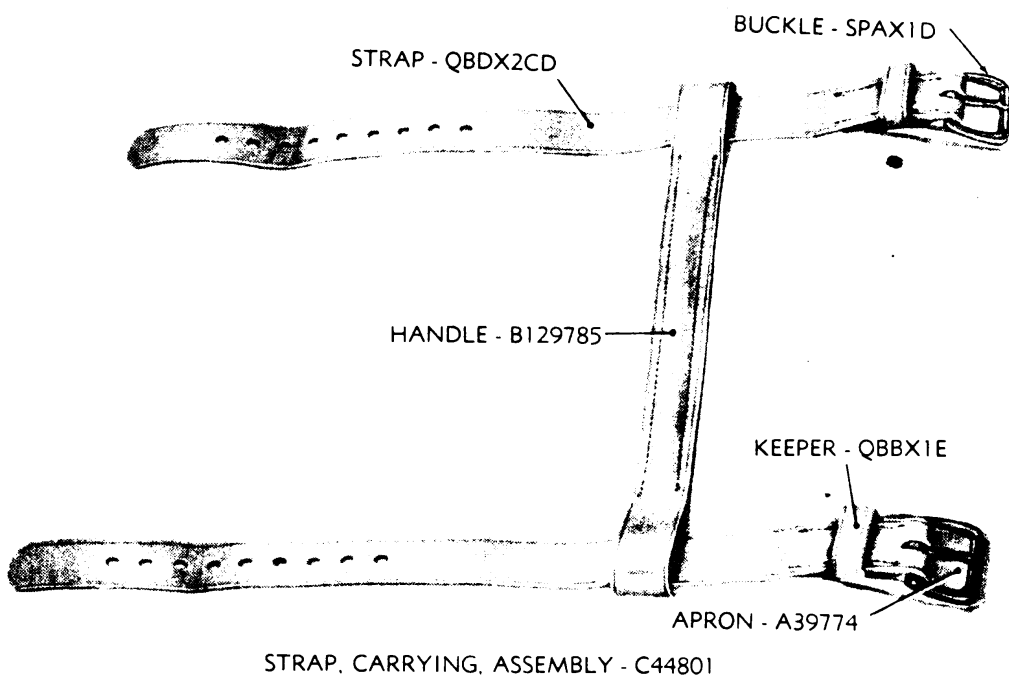
Figure 115—Telescope Chest With Accessories

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RA PD 55531

PACKING, STORAGE, AND SHIPMENT



RA PD 55532

Figure 117—Tripod Carrying Strap

ORDNANCE MAINTENANCE—ANTIAIRCRAFT BATTERY
COMMANDER'S OBSERVATION INSTRUMENT M1

Section XIII

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46. STANDARD NOMENCLATURE LISTS.

- a. Cleaning, preserving and lubricating materials; re-coil fluids, special oils, and miscellaneous related items SNL K-1
 - b. Instrument observation, A.A., B.C., M1
Telescope, elbow, M35
Telescope, M3 SNL F-58
 - c. Kit, repair, instrument SNL F-206
 - d. Telescope, elbow, M2 SNL F-58
 - e. Tripods (all active types) SNL F-101
 - f. Truck, repair, instrument, M4 (for field artillery and coast artillery) SNL G-92
- Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" OPSI

47. EXPLANATORY PUBLICATIONS.

- a. Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department TM 9-850
- b. Instruction guide, the instrument repairman TM 9-2602
- c. 3-inch antiaircraft gun materiel (mobile) TM 9-360
- d. 90-mm antiaircraft gun materiel M1 and M1A1 ... TM 9-370

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O.O. 461/34972 O.O. (4-1-43)

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OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

Distribution: R 9(2); Bn 9(1); C 9(4)

(For explanation of symbols, see FM 21-6)

G. C. MARSHALL,
Chief of Staff.

NOTES

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